

Microbe Whispering In



Covid Times



By JeM YinJoy, Ph.D.

Copyright© JeM YinJoy, Ph.D., November 2020

All rights reserved. No part of this book may be used or reproduced in any matter whatsoever, without written permission from the publisher except in the case of brief quotations, (brief defined as no more than 50 words), embodied in relevant articles and reviews. To request permission or additional information, please email publisher at DrYinJoy@comcast.net.

Disclaimer: This book is intended for educational use. Neither the publisher or copyright holder may be held liable for any misuse or misinterpretation of the information contained within this publication.

United States Copyright

This publication is registered at the United States Copyright Office.

*Microbe Whispering in COVID Times:
A Mystical Path through Science*



Dr. JeM YinJoy, Microbiologist and Microbe Whisperer

*Microbe Whispering in COVID Times:
A Mystical Path through Science*

By Dr. JeM YinJoy

Publisher: Microbe Whisperer, LLC

Dedication

This book is dedicated to Aspiring Microbe Whisperers who create a fearless future for Mother Earth.

Preface

The Call from Spirit

While I was in graduate school studying environmental microbiology, I endured hardship from the hazing that is a unique and accepted practice in science graduate school—most especially due to the prevalent sexist beliefs that challenged the self-esteem of budding women scientists like me. This kind of attitude is entrenched and has dominated the way that scientific studies are approached in the westernized, patriarchal system. It is an approach that leaves little room for wisdom from other traditions that incorporate the feminine perspective. I am myself of indigenous heritage but was raised Catholic. Although Catholicism is rich with sacred mystery, I rejected this religion after graduating from my Catholic high school; after mastering the teachings of Catholicism, I realized that this system of beliefs did not empower the Feminine Divine. This realization was deeply painful for me, a young woman who felt honored by the powerful blessings of being female in this lifetime and who sought a system of beliefs that supported the Feminine Divine. Discouraged by Catholic patriarchy, I gravitated toward more nature-based traditions, including those of the indigenous cultures of the Americas. The connection I felt to my own indigenous American heritage was bolstered within the community of spiritual seekers that I discovered in Upstate New York. This group included a Lakota elder who taught me the Native American traditions of Inipi lodges, vision questing, and the shamanic journey. I had already been prepared for this kind of spirituality, as the dreams of animal guides that I had been having for several years prior and the private rituals I had pursued under the moon and in the forest were given a clearer focus when I learned about journeying in a more structured way and within the shamanic context. This is how I finally embraced the spiritual facet of my indigenous American heritage. It helped me endure the pressures unique to science graduate school training and unique to how such a male-dominated system affected an indigenous woman like me in particular. It was through shamanic journey that I learned to listen to the words of my animal guides, and these guides helped me through some difficult times during my nascent science career.

Becoming a Microbe Whisperer

One of these difficult times came two years into my research, when the microbial consortium I was working with to accomplish my doctoral research died out! A microbial consortium is what we microbiologists call an assemblage of microbes that act collectively to display a similar characteristic, such as the ability to eat the environmental toxins called polychlorinated biphenyls (PCBs). When I say they “died out,” I mean that they basically stopped doing what they were supposed to do, which was to consume the PCBs as they and their progeny had been doing for two years over the course of consecutive transfers to fresh growth flasks containing (a type of) PCBs as their food source. There was no way to resuscitate this population by growing them individually, as all the microbes accomplishing

this unique metabolism I had discovered had not yet been identified. I had frozen microfuge test tubes (special small plastic tubes) of the consortium and had protected them from freeze damage with glycerol. But there was no guarantee that all the members of the consortium had survived and had retained their ability to metabolize the target compounds. Losing this consortium would have demolished two years of research and would have seriously derailed my plans to earn the PhD. I thawed out and tested the cultures from every single tube, and I was down to the final one. I had done everything I could with the tools of science but without success, as the consortium still seemed to have lost its ability to degrade the special type of PCB on which it had been growing and upon which my research depended. So I turned to a shamanic solution. The shamanic elder told me that I had to “raise the energy” of the earth where the growth flasks that contained the microbial consortium were located. There were a few obstacles to this task. First of all, my laboratory was seven stories up a tall brick building. Plus, I was a student at an Ivy League university. Mixing Native American shamanism with laboratory test tubes and flasks would not have been acceptable in the eyes of the professor who ran the lab—or my colleagues, to say the least! Still, I was desperate to revive my microbial consortium. So I recruited a like-minded friend, and at midnight, we visited my laboratory. We collected soil from the four corners of the building and asked Mother Earth to bless my request. Then, while keeping a sachet of blessed soil close to our hearts, we went up to the lab, where we held each of the growth flasks. These growth flasks contained the subdivided contents of the last remaining tube of my special bacterial consortium. Cupping these flasks lovingly, we sang to them.

We sang to them from the array of songs that we knew. We sang songs to awaken the spirit of the microbes in the flasks. And it worked! After six previous unsuccessful attempts to grow the frozen consortium, the seventh tube, the contents of which had been distributed into the growth flasks, gave me the result I needed! By raising the energy of Mother Earth and singing to the faltering culture, I was able to successfully cultivate a PCB-degrading microbial consortium again. Although I had felt a spiritual connection to the microbes before, this was the first time I felt I had communicated with them by directing spiritual medicine. This was the first time I felt that they had heard me and had responded to me—in this case, to an urgent request. It was the first time I realized that, when asked in a reverent manner, they would start doing their thing again and degrade PCBs! It was at this moment that a sacred dialogue began. It was to become one of many moments like that one. It was when I realized that the spirit of the microbes can be awakened by whispering to them. That is how I became a Microbe Whisperer!



Fig. 1. Microbe Whisperer.

Microbe Whispering in COVID-19 Times

Given my sacred journey with the Microbe Spirit Guides, I was moved to respond to the call from the spirit again when the novel coronavirus pandemic upturned our world in February 2020.

Microbe Whispering is about communicating with our Microbe Animal Guides, and the virus that is responsible for our current pandemic is a microbe. So it made sense to me to dedicate a booklet to how to apply the Microbe Whisperer, Microbe Spirit Guide approach to the SARS-CoV-2 virus. This virus has shown up in our world to make sure we hear a message that is vital to our planet. We must "Microbe Whisper" to this virus to receive its lessons. And I am sharing this knowledge of Microbe Whispering with all of you, aspiring Microbe Whisperers. Use it with joy.

Contents

1 - What Are Microbes? 4

2 - What Are Animal Spirit Guides? 6

3 - Communication with Animal and Other Spirit Guides 7

4 - Communication with Microbe Spirit Guides, including Virus.....20

5 - How Does the Novel Coronavirus Attach to Our Bodies?39

6 - What Sorts of Strategies Can Kill It?62

7 - Science and Sci-Fi72

8 - Magic76

9 - Spiritual Lessons from These Teachers.....80

10 - Where to Learn More about the Novel Coronavirus Science and Medicine94

11 - Meditations to Help You Purge the Virus and Increase Immunity.....95

Acknowledgements

I would like to acknowledge the support and encouragement of my friends and fellow mystical seekers who have been eager to become Microbe Whisperers too.

I also want to extend my appreciation to Eric Carlsen, who has mentored me on graphic design software.

And finally, my sincerest gratitude to my editor, Chelsea Wing, who acted as proofreader and formatter and ensured that the layout in my manuscript conformed to standard methods of style.

Introduction

What do you think of when you see the word "microbes"?

It is the question I pose when I introduce Microbe Whispering to a class. The answers I get are wide-ranging: small, disease, gross, bad, sick, tiny, invisible, etc.

However, after I complete my class on how microbes are good for us and for our planet, the words change when I pose this question again. Now when I ask, "What do you think of when you see the word 'microbes'?" the words offered are: amazing, beautiful, cleansing, good, healthy, interesting, etc.

This booklet begins by providing the biological definition of what microbes are, based on the factual evidence the scientific community, and microbiologists specifically, have agreed upon so far. You can then proceed to my stories explaining what animal spirit guides are, to better understand the nature of a Microbe Spirit Guide. I use my original card deck, *Microbe Whisperer Cards for Environmental Healing: Divination and Education*, to teach about Microbe Spirit Guides. This deck consists of forty-four illustrations of microbes that are good for Mother Earth. Even though forty-four is a small sample size of the trillions of microbial species in our world, the Microbe Guides in my card deck still give effective answers to many questions.

You will learn the steps to take for communicating with the Microbe Spirit Guides. Some of these steps include samples from my original Microbe Whisperer Card Deck.

The forty-four microbes (or microbe groups) represented in my Microbe Whisperer Card Deck are nonpathogenic microbes, or at least nonpathogenic to humans. But even microbes that are pathogenic (those that make us sick) can be better understood by asking the Microbe Animal Guides. As an important consideration, do note that the term "microbe" includes viruses.

To seek the virus as a Microbe (Virus) Spirit Guide, you should understand its biological nature. That information will be addressed in the science portion of this booklet.

You will learn about the COVID-19 virus, which has infected millions of people worldwide, with a death toll of over 650,000 by the end of July 2020, according to data from about thirty-two countries.¹

The framework of this teaching will be given within some of the history of our human pandemics and will provide you with some background on molecular biology and epidemiology. How vaccines are being created is also described. The race to develop an effective vaccine against the SARS-CoV-2 virus has scientists working with unprecedented celerity. Thankfully, the vaccine developers are also

wielding twenty-first-century medical and biochemical techniques, which help with this accelerated medical accomplishment. These techniques will also be described.

This booklet is to be used as a source of spiritual comfort as well as factual information to help you navigate the uncertain and ever-changing landscape of this global health crisis.

There are also some outside-the-box concepts to satisfy your curiosity on how science fiction and fantasy might inspire inventions to help us with long-term solutions to this pandemic as well as maladies that are poised to pounce on a world that spins in and out of control.

To bind together the information and concepts that are presented, you will read about the mystical interpretations from the Microbe Spirit Guides and receive some meditations to apply these messages. The goal with this offering is to help strengthen your coping skills as you deal with the ramifications of this pandemic.

This Booklet

You can acquire strict scientific facts from scientists, entertainment from fiction writers, and spiritual comfort from religious institutions and those who minister within them.

But in this booklet, you will find a rare alchemical blend of mysticism and science. This uniquely bubbling brew allows for your spiritual intelligence to understand messages from Microbe Animal Spirit Guides. To that end, I offer valid scientific knowledge supported by facts from peer-reviewed articles and established, well-respected educational and public health sources. And I swirl into this knowledge a special ingredient. This ingredient is the mystical approach that is the hallmark of *Microbe Whisperer Cards for Environmental Healing: Divination and Education*.

THE WAY TO ILLUMINATE THE DARK FEAR OF THE UNKNOWN IS BY THE REVELATION OF KNOWLEDGE.

Once illuminated, darkness is gone, and even a rocky, steep, and difficult path can be navigated with confidence. Those who believe that microbes are "invisible" will of course be terrified of the light, because no light can shine upon an "invisible enemy," and because an "enemy" that cannot be seen will create more inner demons. Phantasma curling up from our worst fears becomes more mentally and emotionally crippling than actual reality. With reality, we can at least be cognizant of what the challenges are and be better able to meet them with whatever measures are deemed necessary by our collective wisdom.

By becoming enriched with basic facts about the natural world inhabited by microbes, you can become more comfortable, seeing the world through their

"eyes" and imagining feeling the rush of microhabitat elements pouring through their miniscule bodies. You can understand being light enough to travel within a drop of water suspended in the air.

This will allow you to understand the reasoning behind the measures that we need to take so that you can protect yourselves from the aerosols that virus particles occupy and surfaces upon which they concentrate. By understanding the virus's sensitivities to environmental factors, like temperature, dehydration, emulsification, or pH extremes, you can be more informed about where public health officials are coming from when they advise us on what we must do as a population to stay safe.

This booklet is to be applied by you, aspiring Microbe Whisperers, to bring you some peace in terms of Microbe Spirit guidance and resources as scientific facts.

This helps you to not give in to fear, but rather to be supported with real knowledge and a sharper awareness of the world that we coinhabit with trillions of microscopic, wise, and vibrant beings, including the virus that causes COVID-19.

What Microbe Whisperer provides here is an insight, an approach, a perspective of the multifaceted gem of how to work in harmony with our fellow planetary dwellers.

With this booklet, I provide ways for us to learn from other microbes about how they survive attacks from their own viruses: the phages.

I also give you the opportunity to observe the novel coronavirus the way you might if you were a visitor to an aquarium. And just as the fish, dolphins, anemones, and seahorses that swim in their habitats behind glass walls are fascinating to watch, this experience, entering my "aquarium" display of microbes, may be just as enthralling.

Imagine that as a visitor to my imaginary aquarium, you can view bacteria and viruses—all manner of microbes, if you will—enlarged to the size of aquatic creatures. And imagine that you can learn how they live in their natural worlds as they feed, fight, and procreate.

You can do this imaginative exercise with me, a microbiologist by training who is gifted with an innate intuition for animal guides. As your personal Intuitive Microbiologist, I am providing an easy-to-read understanding of what microbiologists (and virologists) see under the microscope lens during this developing crisis; what they are learning about COVID-19; and how they are giving

us ways to help us survive exposure and infection by the virus that is responsible for our current pandemic.

In my "Microbe Whisperer Aquarium," I have dedicated a "Hall of Viruses" for your edification. And in this hypothetical "Hall of Viruses," there is one special tank. It is a tank devoted to the SARS-CoV-2 virus to provide you with deeper insight on this virus that has drowned our collective lungs.

I hope, dear aspiring Microbe Whisperers, that your experience with the word "virus" has an empowering effect after you read this booklet. After all, no matter how much a situation may negatively affect us, it is by gaining knowledge of a thing, especially something frightening, that we become empowered to face it. And once we face that thing that frightens us, it does not seem so difficult to perceive and understand. From that vantage point, we can avoid or vanquish the thing that had previously rendered us victims. This booklet is meant to help us all as we do our part to wield a victory over the COVID-19 pandemic. It is as victors that I envision us moving forward. And in this promising scenario, we all enter a future filled with wisdom from the lessons learned, as channeled by this tiny, strident Virus Spirit Guide.

1 - What Are Microbes?

- **Definition of Microbes**

Basically, microbes are single-celled, living creatures that are too small for humans to see without the use of a microscope. Our eyes can see creatures as small as the diameter of a human hair or human egg (ovum), about 0.1 mm (1 mm is a millimeter, or 1,000 times smaller than a meter). But for things smaller than 0.1 mm, like blood cells and yeast, we need a special lens of some sort to magnify and resolve them. This includes not just bacteria, but also microscopic algae, diatoms (which are like microalgae with a glass coat), microscopic fungi, and protozoa. Viruses are also microscopic, but they "come alive" after they have hijacked the genetic machinery in a living cell.

Since this booklet focuses on the novel coronavirus that causes COVID-19, we can include viruses in my definition for microbes. We can do this by adding to the definition above that microbes are single-celled, living creatures or creatures that have the capacity to "come alive" within a host cell.

- **Definition of Life**

For biologists, philosophers, and those of us interested in discovering extraterrestrial life, the definition of life becomes an unwieldy one. Some definitions, such as the one proposed by NASA—"Life is a self-sustaining chemical system capable of undergoing Darwinian evolution"²—exclude mules, for example,

since mules (hybrids of donkeys and horses) cannot reproduce. And some folks who would like to define an artificial machine as a life-form would like to exclude the necessity for nucleic acids (DNA/RNA) or carbon-based proteins and other compounds as part of the definition of life. It is not so far-fetched to define life that way.

In fact, some creatures already exist that do not contain DNA/RNA. These are prions, which consist of proteins that fold in unique ways and are responsible for mad cow disease and more. They also may be helpful in ways we have not yet discovered. Prions will not be included in the definition of "microbes" in this booklet. It is currently a consensus among leading biologists that prions are not alive, even within their host. They are considered "infectious proteins."

- **For This Booklet**

For the purpose of this booklet, "living creatures" will refer to life-forms that contain nucleic acid to make proteins that are carbon-based.

Even though microbes are too small for us to see with our unaided eyes, in the microscopic world, there is a large variation in size. A virus is many, many times smaller than an average bacterial cell. An example is the difference in size between the influenza virus (0.1 micron) and the *Staphylococcus* bacterial cell (1 micron), where the influenza virus is ten times smaller than the *Staphylococcus* cell.³ The unit of measure used here, the "micron," is a unit that is 1,000,000 times smaller than a meter. So 1 micron, or 1 um, equals 1/1,000,000th of a meter. We're lucky to have microscopes that allow us to "see" into what was previously an "invisible" world!

My previous publication, *Microbe Whisperer Guidebook for Environmental Healing: Divination and Education*, deals with microbes that include microscopic fungi, algae, and phages (viruses that use bacteria as hosts). The term used for the previous guidebook will also apply to this booklet, so the term "microbes" will refer to bacteria (both Eubacteria and archaeobacteria), microscopic fungi/algae, and viruses.

In my Microbe Aquarium's "Hall of Viruses," the tank that is designed for specialized viewing of the viruses, the viruses are large enough for you to see without a microscope. This special habitat will be divided into sections, so you can view the novel coronavirus in its "inert form" and also when it comes alive as it attaches to a visible ACE2 receptor on various types of hosts, such as bat or human tissue.

2 - What Are Animal Spirit Guides?

Animal Spirit Guides

To understand what *Microbe* Spirit Guides are, first let's talk about animal spirit guides.

In the past, all of our ancestors relied on signals from nature to guide their choices in their life journeys. They used the stars to navigate and to learn about themselves. They had dialogues with the plants and trees. And they observed the animals around them, learning from them and being guided by how these animals survived using their unique body types and abilities to eat, ward off predators, and survive through the changes in the seasons. The lessons that our ancestors learned from animals were immortalized in oral history, then written history. Our forebears recognized the spiritual energy from these creatures and called this spiritual representation of the animal an animal spirit guide.

Honoring animal spirit guides happens in many forms throughout human history and transcends many cultures. One of these many forms is the creation of art depicting the power of animal survival in nature and illustrating the grace and beauty of the winged, furred, and scaled ones in their respective habitats. We have worn their pelts in ceremony and created masks of their feathers in rituals. We have shared stories in physical written and painted form, digital form, and film. By role-playing, watching, and envisioning ourselves cloaked in the furs of a powerful beast, or sailing over an ocean on the wings of a favored bird, or gathering nectar from flowers for our collective, we empower ourselves with these ancient genetic memories. As we immerse ourselves into recalling these primal energies, we discover how to infuse them into our human lives for improved vigor.

Is our connection with our kindred earth creatures based on genetics? Within our human genomic sequence reside vestiges of our evolutionary past. Modern molecular biology has shown this. These braided genes wind betwixt fox and bear, eagle and snake, fish and whale, and include humans within this intricate base-paired lacing that extends from ages past, perhaps bestowing upon us that feeling of kinship. Or is there some method of conscious connection we living creatures make with each other that transcends the mere corporeal? Perhaps the mutual brushing of electron clouds when we pass each other in the wind or the water creates a resonance with that part of us that recognizes a common bond. Then again, there may be a mystical explanation, a spiritual one, that can be tested through experiential means, and which varies from human to animal filter. Each head contains its own universe of interpretation. ("*Cada cabeza es un universo*" is a proverb my father favored.)

Because of the universal truth that this proverb encompasses, I want to make something very clear, just in case you're concluding that animal spirit guides and animals are the same thing. Working with an animal spirit guide does not require that the actual animal in physical form, in its natural habitat, be anthropomorphized—that is, given human characteristics and motivations. It would be a mistake to superimpose our own perceptions onto another creature. This would prevent us from understanding and appreciating another living being for who it is, how it is, and where it fits into the natural tapestry of our world.

Living creatures that cohabitate with us on this planet are interconnected with us. If we are aware of our own divine light force, or have conversations with the Divine, invariably we will experience a sense of oneness and a sense of a shared flow of energy between us and nature. I am sure you have sensed that soulful elevation that appears to transcend your body when you are having a spiritual experience. Or maybe it's a thrill in the chest when you watch a flock of herons take flight. Finding that spiritual elevation when you watch a fawn bounding after her mother or a bee pollinating a flower creates that awareness of how every bit of the natural world has a lesson for us by simply showing up fully as its lively, flowing, and glowing self.

When we meditate upon animal spirit guides, the spirit of the heron, bee, or fawn will arrive in that arena of our mind's eye simply as itself too. But we will be vividly focused and aware of its nature and its actions. And our own connection with the Divine or our personal awareness of our own divinity will help us interpret how that animal spirit guide is showing up with illuminations, revelations, and answers.

For this sort of communication with ourselves and the natural world, we do need to know how this animal actually behaves in its own habitat to derive the most guidance from its nature.

3 - Communication with Animal and Other Spirit Guides

Communication with Animals

We have all had that moment of recognition with a fellow creature. No matter what your religion, spiritual practice, or cultural background is, we have all done this. We have all felt that the voice from the Divine can be heard in the form of animal messengers.

You can be taking a walk in the forest, buried deep in your problems perhaps, when two squirrels go running past you. This can remind you to lighten up, to go

"nuts," or to do something you haven't done for a while that will bring you as much fun as those two squirrels were having just then.

I learned how to communicate with animal guides and spirit guides in several ways. You can too, because you yourselves have some aspect of spiritual communication in many diverse ways, depending on your cultural and societal spiritual practices.

What I am sharing here stems from my own evolution in spiritual practices. The purpose of describing these is simply to give you some guidelines on how to access these practices in your own way.

When I was attending grad school and earning my PhD research science degree, I sought out some spiritual support. I was in need of it due to many pressures and ongoing traumatic experiences. I was also between spiritual practices at that time. Having left the Catholic Church after high school and having explored various Asian and pagan practices, I did not have a particular spiritual path that I shared with others and that meshed with me.

I searched out and discovered a tribe of folks who had been doing Native American shamanic rituals on their forested land. They had a relationship with several Native elders who taught them these rituals. Perhaps given that I have a high percentage of First People's blood coursing through me, these practices resonated strongly.

From this group, I learned how to "do medicine" in purification lodges and how to create tobacco ties and meet spirit guides in Dreamtime. To "do medicine" in shamanic practice is loosely equivalent to praying in Christianity or observing rituals in pagan practice. In a basic sense, it involves calling upon spiritual resources to effect a goal, such as the relief of an illness or the safe passage of a loved one. Purification lodges are more commonly known as sweat lodges. But Inipi is the proper term for this sacred practice, which is a rite of purification.

I did not start working with animal guides right away. Just before meeting this group, I had been dreaming of an extinct creature. I was dreaming of an archaeopteryx. I thought this was unusual, since in the practices I was learning, the people spoke of communing with animal spiritual guides such as the eagle, buffalo, or wolf—basically, animals that were part of our current community of cohabitants on earth, not extinct ones. I'd known about the archaeopteryx since my childhood fascination with evolution. This creature was known to be the possible root progenitor of class Aves (birds) and class Reptilia (reptiles).

I had been wrestling with skepticism about some of the shamanic practices I had been learning about. After all, one of the elders claimed to have traveled to the moon during a spiritual quest and to have returned with moondust in his hand! My

scientific training was at odds with the transcendental realities I was learning about from these spiritual leaders.

But archaeopteryx came to me in a dream. I had not been learning about such extinct creatures in my grad school work. It wasn't part of my daily consciousness. So its appearance was highly unusual to me. This led me to pay respect to this practice of working with animal guides. My respect allowed me to discuss the Dreamtime experience with one of the elders, and he taught me about the topography of the shamanic journey landscape.

Shamanic Journey Landscape

According to the elder who taught me about the shamanic journey landscape, all those who go on a shamanic drum journey go to the same basic landscape. It is considered to be a real place, which can only be reached via shamanic journey where the shamanic or altered trance state is induced by a steady, rhythmic drumming.

The journey landscape, I learned, consists of three worlds: The Lower World, the Middle World, and the Upper World.

It is in the Upper World that we meet our spiritual guides, such as saints, angels, fairies, wizards, and even objects you would not normally think of as guides, such as planets or trees. I have had the planet Mercury manifest as a spiritual guide, for example. The landscape varies and can be very much like a vivid dreamscape in which your guides appear in diverse forms and commune with you, usually in your language rather than symbolically. The Upper World holds many surprises for you as well.

In the Middle World, you ask for a manifestation of your heart spirit. Sometimes, the manifestation of your heart spirit does not look like anything similar to you in your earthbound life. In this Middle World, you can meet and converse with the heart spirits of the departed or with the heart spirit of someone you cannot speak to in real life. Let's say you are having problems with a difficult boss but you cannot confront them without losing your job. You would go on a journey to the Middle World, having your heart spirit meet with the heart spirit of that difficult boss. In the Middle World you can safely air your concerns, heart to heart! Believe me, it really does effect changes in your relationship with that person. You can do this with a departed loved one too. I did this when my mother passed over. There is an incredible and sacred intimacy to doing journeys in the Middle World via your heart spirit and meeting the heart spirit of another.

The Lower World

The Lower World is where you meet with your animal spirit guides, and it can be replete with symbolism. The language is not yours; usually it is subject to interpretation of the particular animal guide that has a message for you.

You interact with the animal spirit guide by joining them in their habitat. Sometimes they allow you to ride them while they fly, swim, or hunt in the forests. Sometimes you flit beside them while they do next to nothing—at least, nothing you are aware of—until they allow you to see through their own compound eyes. Or you can walk beside them while they feel the ground with their own sleek, limbless bellies. They might allow you to feed or groom them, which must be done with great respect, as this privilege is bestowed as an honor.

Animal Guide Practice

After years of doing shamanic journeys with animal spirit guides, I learned that I could gain insights and messages from the animal spirit while interacting with the animal itself in real life.

○ Seven Songs to a Snake

I was in a difficult relationship and needed to get away from him once in a while for my own sanity. There was a little spot I knew about in the Bridal Veil Falls, Oregon, area.

I'd go there on Sunday mornings, rather religiously, equipped with my meditation CD and headphones. I'd settle into my spot near a young tree. From my partially hidden vantage point, I had a full view of the 188 feet of a graceful, white-capped cascade called Bridal Veil Falls, as well as the observation deck below it. With this fantastic view and a cushion of leaf-covered soil, I'd rest my feet at the base of the young fir and enjoy my meditation chants.

I had been doing this weekly pilgrimage for about two months when, one Sunday morning, I was in for a sacred surprise. As I reached my meditation spot, I was startled by the sight of a coiled garter snake. She had been settled in for a snooze, comfortable at the base of this tree where I usually placed my feet!

Rather than leave, I felt perhaps we could both share the spot. Glancing at her head, I knew she was a harmless garter snake from her head shape and color.

Honoring her space and her boundaries, I sat in my usual spot, with my booted feet perhaps a foot away from this new friend.

I was so careful and quiet to not disturb her. Nevertheless, her sensitive nature knew I was near, so she lifted her head slightly to look at me.

I started to hum a tune and then sang a song, most likely from my repertoire of soft rock songs. The snake did not move; she appeared to listen, as her tympanic membranes vibrated slightly while I sang. I continued with my singing, and to my amazement, she placed her head back down to continue her nap. It wasn't until my seventh song that the snake stirred again. This time, she uncoiled slowly and seemed to be finished with her time there under the base of the tree. As if to thank me, she slithered slowly away, making sure that her belly passed over the tip of my boot. She left, perhaps on her way to a quieter nook.

I remained to meditate, and, placing my feet in their usual spot at the base of the fir, I felt that my feet were especially blessed that day from the sacred snake energy. The snake represents, among other things, the power of transformation. Not long after this, I chose to permanently leave the abusive relationship that I was in. Maybe the snake that day carried a message from the spirit world that took a form I needed to understand from the nature of this creature in the real world—that of shedding an old skin in my transformation to a better life.

○ **A Sea Lion's Kiss**

I went to the ocean and asked the Goddess of the ocean if she would help me open my heart. Moments later, a sea lion beached and vomited some greenish fluid. He was obviously very ill. I asked a few passersby to please get some help. Then I sat on some rocks overlooking the majestic creature with his head resting on the sand below. After sitting quietly, I realized he was probably in his final moments of life. So I was moved to sing, softly humming at first.



Fig. 2. Author's rendition of singing to the sea lion (done in acrylic paint on canvas).

After a few bars, he opened one of his brown eyes and looked up at me. I stopped singing because I wasn't sure that he liked it. As if to answer my question, he used his remaining strength to drag himself directly under me. Then he gave me a look with his two eyes that very clearly said, "Go on!" And he flopped his head back down on the sand, as if waiting for me to sing. Encouraged by this, I sang all the soft and sweet songs that I knew.

I finally stopped and, needing a break, stepped off my boulder perch. Standing beside my suffering new friend, I gently told him I was leaving for a moment, but that I would be back.

With much effort, he heaved his glistening brown head up again, and, to my great surprise, he planted a wet kiss on my wrist, as if to say, "Thank you!" I was stunned and grateful. One of my companions, who had been observing, did not see it the

same way. He was worried that the sea lion would bite me. I told him all was well and not to worry. Then I went back to our campsite to make some tea.

It turned out that the sea lion's kiss was not just "thank you" but also "goodbye." He died shortly after I left.

Some kindly friends and I created an altar of driftwood and shells around the sea lion's body. I touched his sleek fur and the moist nose that had touched my wrist in a kiss moments before.

A loving couple held their wedding beside that boulder later that day. Someone strummed songs on a guitar to celebrate their bliss.

I kept vigil beside the sea lion and watched the sunset over the sea.

My heart was cracked open by this sea lion's generous spirit and the Goddess's answer to my prayer.

I knew that I would never be the same...because I sang to a dying sea lion who showed me love. And because his spirit wrapped his tail around my heart, letting me know that somewhere in the cycle of life and death, we would cross paths again.

❖ A Kaleidoscope of Messages

Ever since I started dreaming my first animal spirit guides, I have been deeply blessed by their messages throughout my life and to the present.

- **Snail** - A stunning white-shelled snail visited me during a sacred vision quest on the land of my friends in Ithaca, New York. The snail took the entire night to crawl up the wooden staff I had planted in the center of my circle. This wondrous snail brought me many revelations. Since they were part of my personal vision quest, those messages are profoundly private. They are wise insights between me and my spiritual guides. However, I can tell you that the snail as an animal guide brings certain kinds of wisdom.

The snail symbolizes the sacred spiral. From the way it lives, creating its own home integrated with its body, it also teaches us to carry homey comforts with us. And as the snail grows, the shell grows with it, symbolizing that the lifelong lessons we learn give us the knowledge to deal with the same crisis with better tools, gained from the growth in our wisdom. The snail leaves trails that look like gooey fairy dust as it muscles its way across the soil and leaves. These trails are symbolic of

the brilliance of our presence and the fact that we leave those sparkling traces of this unique presence of ours as we wend our way through our community of friends, family, and work. The other lesson of the snail is its pace of movement. The snail takes its time to reach its destination, but it does get there eventually. This teacher shows you to not be concerned if a certain goal seems to be taking a long time. The snail is slow but steady. And the snail uses its sensitive feelers for an ultrasensory experience of its world. All these things are missed when we go rushing along. Slow down, honor the sacred spirals of your life, leave sparkles of your unique presence when you pass, and carry your comfort with you: These are the lessons of this lovely gastropod spirit guide.

- **Hummingbird** - I was attracted to a woman, but she was dating someone else. I didn't know how to express my feelings for her, as there were several layers of blocks for me to overcome. But while I sat with her, looking out the window of her car, a hummingbird appeared in front of me!

I knew this animal guide! Hummingbird has been a totem for me for many years. And I knew, from my work with Animal Medicine Cards, that hummingbird brings the medicine for romantic love. Hummingbird teaches us to drink from the sweet nectar of life blooming all around us. So this teacher appeared exactly when I needed to appreciate the lessons on embracing love in all its beautiful forms!

- **Bat** - The bat flew right into my face while I was trying to make a financial decision on buying a used black pickup truck—a Ford Ranger. I had already made the other inquiries necessary for buying a used vehicle. I just had to decide if I needed to negotiate a better price. It was not even dusk when this bat flew into my face and on the tailgate of the truck! I immediately knew that this truck was going home with me. And I named my new truck "Bat-Magic"!
- **Eagle** - I was feeling discouraged. I had just been thinking about giving up on a project due to naysayers, both external and internal. Then the eagle appeared, at eye level, outside my kitchen window. This was a bald eagle, and why he was hanging on such a low branch became apparent. He was being bullied and chased by a murder of crows! I saw his eye, his large yellow beak, and his noble white and black plumage.

Immediately I went out and encouraged him to fly high. I told him that he could outfly those nasty crow-bullies. He flew off, and with him he took my blessings and encouragement. I realized the lesson was very

clear. Rather than give up on my own project, I should remember the parable of the eagle who grew up in the henhouse.

❖ **The Eagle Who Hatched in a Henhouse**

The short version of the story goes like this. Somehow, an eagle's egg rolled out of the nest and into a chicken coop. A brood hen figured it was one of her own and sat on it till it was hatched. The eaglet grew up with his sister and brother chicks, always thinking that he was a chicken like they were. And when the large shadow of an eagle would darken the chicken coop, the eaglet would hide with the other chickens, never dreaming he was an eagle too.

The story ends in one of two ways. The eagle lives out his life in a chicken coop, never realizing his true nature, never lifting his head up from pecking the ground. Or, one day, he sees his own reflection, flexes his mighty wings, and soars out of the coop. By recognizing his true nature, he embraces his majestic destiny to become ruler of the sky.

I remembered this story when I spotted the eagle being chased by crows. This scenario represented the bullies, and naysayers, and haters in my life, the "crows," trying to pull me (the eagle) down.

It helps when the eagle animal spirit guide enters its own flesh on this plane to teach me the lesson of flying higher than the crows. The lesson from the eagle is that by shaking off those who would keep me penned with my head down, I can fly high and away, ruling the skies of my own destiny with this flight to the stars.

❖ **A Mention on Medicine Cards**

After I started working with animal spirit guides, I found Jamie Sams and David Carson's *Medicine Cards* to be very supportive and helpful in my newfound path. Another book that I found helpful is *Animal Speak* by Ted Andrews. Not all online animal spirit guide or animal medicine guide websites are true to the Native teachings.

I found one called Animal Shamanism to be very in-depth and insightful. Others have various spins on them, depending on the background of these websites. If you do own an animal medicine guide card deck, create your own personal stories with each of the animal guides. Learn about their natural habitats by visiting in person, viewing nature videos, or reading. This will help you learn more about the animals themselves so that you can better communicate with their spirit guides.

○ **Microbe Whisperer Oracle Cards**

Jamie Sams and David Carson's *Medicine Cards* inspired me to create an original oracle card deck: the [Microbe Whisperer Cards for Environmental Healing](#), which I already mentioned. The suits for the forty-four [Microbe Whisperer Cards](#)

correspond with the suits you know from the tarot deck. But the symbols I use for my suits are those of the tools that microbiologists use in the lab to “whisper” to these microbial guides.

Loops

This is a card from the Microbe Whisperer Inoculating Loops suit card deck. Loops corresponds to “wands” in tarot decks, even though the Microbe Whisperer Card Deck, at forty-four cards, is an oracle deck, not a tarot deck. The Loops suit represents fire, passion, and inspiration. It was appropriate to place this particular imagery with the Loops suit. The dolphin-riding girl channels the passion and fire within the hearts of all young girls who are inspired by science.



Fig. 3. Card #7 from the Inoculating Loops suit in the Microbe Whisperer Card Deck.

The loops are one of the tools a microbiologist uses in the laboratory to isolate pure cultures.



Fig. 4. Inoculating loop getting sterilized.

Tubes

This is a card from the Microbe Whisperer Tubes suit card deck. Tubes corresponds to "cups" in tarot decks, even though the Microbe Whisperer Card Deck, at forty-four cards, is an oracle deck, not a tarot deck. The Tubes suit represents water, emotions, and flow.



Fig. 5. Card #10 from the Microfuge Tubes suit in the Microbe Whisperer Card Deck.

The microfuge tubes are one of the tools a microbiologist uses to concentrate solutions containing microbes.



Fig. 6. A microfuge tube used in a microbiology laboratory.

A microfuge tube holds very small amounts of liquid, such as 2 milliliters. They are used to centrifuge liquids to concentrate things like bacteria out of the liquid.

Petri Dish

This is a card from the Microbe Whisperer Petri Dish suit card deck. Petri Dish corresponds to "pentacles" in tarot decks, even though the Microbe Whisperer Card Deck, at forty-four cards, is an oracle deck, not a tarot deck. The Petri Dish suit represents nourishment and security.



Fig. 7. Card #8 from the Petri Dish suit in the Microbe Whisperer Card Deck.

The Petri Dish contains sterile, nutrient agar and is used to grow bacteria and detect bacterial viruses (plaques) on a bacterial lawn.

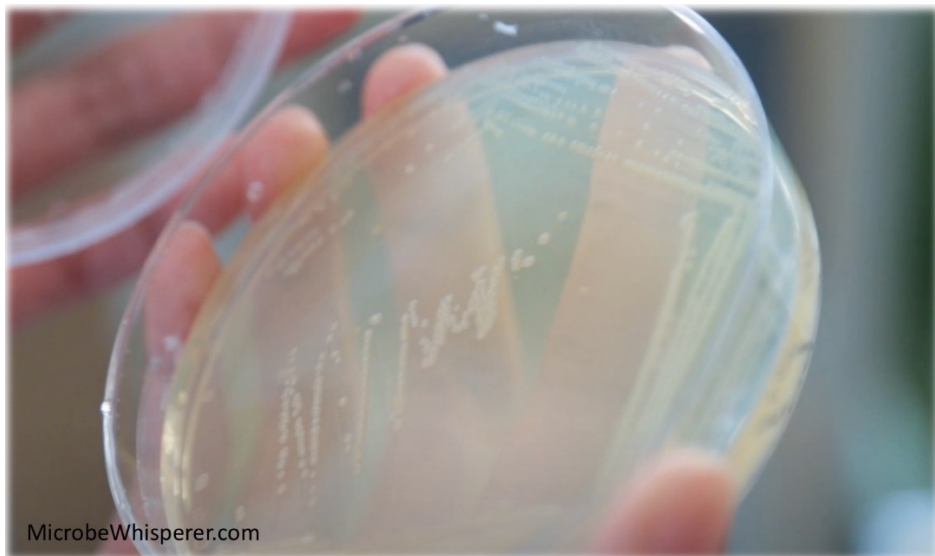


Fig. 8. A petri dish with nutrient-infused agar for growing bacteria in a sterile environment.

Pasteur Pipette

This is a card from the Microbe Whisperer Pasteur Pipette suit in the card deck. The Pasteur pipette corresponds to "swords" in tarot decks, even though the Microbe Whisperer Card Deck, at forty-four cards, is an oracle deck, not a tarot deck. The Pasteur Pipette suit represents clarity of mind and cutting through the heart of a matter.

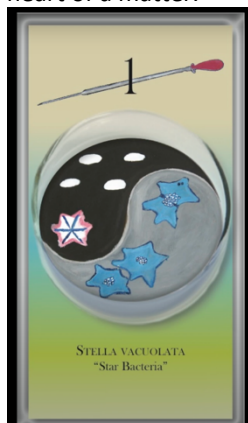


Fig. 9. Card #1 of the Pipette suit in the Microbe Whisperer Card Deck.



Fig. 10. A Pasteur pipette is used to transfer liquids in a lab.

With the Microbe Whisperer cards, I can help you understand how to harness the wisdom of specific Microbe Guides that appear in your reading. The Microbe Guide that shows up in your cards can grant you insights on how they eliminate toxins

and survive. These are skills that can translate to your own lives to help you survive toxins or remove disease—whether physical, emotional, or spiritual. They can provide guidance on how you can flourish within your worlds.

I can teach you how to become a Microbe Whisperer too.

I created forty-four paintings of microbes that are good for the environment. Since I know them so intimately, with my readings, I can tune into thousands of other microbe types using these forty-four representatives from the world of microbes. My relationship with these Microbe Guides can help answer questions of the heart, the body, and the mind and help to conduct your creative flow.

For the best reading benefit with my Microbe Oracle Cards,⁴ I like to give the scientific description of the microbe first. This is to help you become as comfortable working with the microbe in its habitat as you would watching a deer or eagle in its natural home, or as you would observing the microbe in the recreated habitat of the Microbe Whisperer Aquarium. This way you can derive the most benefit from understanding the spiritual lessons from that particular Microbe Spirit Guide. Go to the link here to learn more about oracle readings with [Microbe Whisperer Guide Cards](#).

4 - Communication with Microbe Spirit Guides, including Virus

Microbe Spirit Guides

Microbes are living creatures that are too small for humans to see without the use of a microscope. And just like larger animals, these microbes have unique body types and ways of eating, reproducing, warding off predators, and surviving under the harshest conditions.

Like the larger animals that taught our ancestors back then, and are teaching us now, these microbes have powerful lessons to teach us.

Although our ancestors did not have microscopes, they still sensed the existence of elementals, fairies, and nature spirits—so they were aware that tiny *somethings* were making their spiritual presence known in the forces of nature, and that these tiny things were responsible for keeping gardens fresh and water pure.

But since microbes were not visible to these ancients, a better way to observe these microbes and their ways of life was shrouded in mystery.

It took ingenious and curious minds over the course of centuries to develop more and more sophisticated tools to realize that a universe of tiny trillions lived and grew on our soil, in our water, upon every creature, and within and upon our bodies.

Some of these minds include Antonie Philips van Leeuwenhoek, dubbed the "Father of Microbiology" because he created the first known microscope and discovered tiny creatures on saliva and who knows what else, calling the first-described microbes "animacules." And we know of Pasteur, who disproved the theory of spontaneous generation with his swan-necked flasks and discovered that there are microbes that make our bread rise and our beer ferment. We know from these microbiologists and many others about the wide array of good microbes that exist, which make our digestion easy and consume megatons of carbon waste, among many other lifesaving and useful tasks.

You may wonder now, how is it that you can have a conscious bond with a creature so tiny it is invisible to you? A creature like a bacterium, which has only a modicum of DNA compared to your large genome with millions of base pairs?

Microbe Whisperer "Aquarium"

As I said at the beginning, you can do this in my imaginary Microbe Whisperer Aquarium, where microbes are large enough for you to view within habitats that recreate their natural environments.

Imagine you can watch a microbe nibble on its food as easily as you can a rabbit nibbling on a dandelion. Or imagine you can witness the birth of new baby cells of the smart predator *Bdellovibrio bacteriovorus* as they burst out of their *E. coli* host. Perhaps you might watch the transformation of a bacterial spore as it germinates in water, as easily as watching the time-lapse video of a seedling sprout? Or what if you could witness a slew of bioluminescent bacterial cells lighting up so that its host, the pony fish, can flirt with a potential mate?

If you can see these things in your mind's eye, then you have taken the first steps toward Microbe Whispering.

Microbes do incredible things, and I can assure you, if you had a microdrone's view of their fantastic behaviors, you would be able to understand what these Microbe Spirit Guides teach us. As an Intuitive Microbiologist, I have opened up the portals of communication with these microbes. I have done this by creating an oracle card deck, the Microbe Whisperer Cards, with my original artwork of microbes. These paintings depict where microbes naturally live and how they appear on a petri dish and under a microscope. The artwork also includes renditions of chemical molecules that are integral to the microbe's survival. Microbe Whisperer provides a means for you develop a comfortable understanding of microbes in their

microscopic worlds as easily as you would a living creature that you can see with your own eyes.

When I say “microbes,” most people think about those that cause disease. However, there are trillions of microbes busy on our planet and in our bodies, keeping us clean and warding off disease or eating toxic waste and recycling the gases in our atmosphere to help grow the plants that keep us nourished. Trillions and trillions of microbes belonging to thousands of genera thrive with us on this planet. Because of microbes, our important atmospheric gases are cycled from the air, to the soil, through plants and animals, and back into the air again. Thousands of microbe-types keep Mother Earth's body clean and her circulatory system pure. All of these trillions of microbes have superpowers that can help us live better lives—in harmony with nature and with our own bodies.

Just because they are too small to see does not mean we cannot taste, feel, smell, and touch their transformative presence in our lives. When you grab mud from the ground after the rain and smell it, that pungent after-rain fragrance is created by a microbe! When we had the BP oil spill, never-before-seen spiral-shaped microbes swirled up from the deep to drink as much oil as they could, rescuing us from the aftereffects of this environmental disaster. Microbes that make methane gas gave rise to hundreds of fantastic fables about will-o'-the-wisps dancing over the marshes where these methane microbes make their homes. There are microbes shaped like stars, microbes that came on meteorites to earth, microbes that make bread rise and ferment our food. They help us keep our guts balanced and our skin clean. Microbes terraform the earth and us every day to create a healthy mind, body, and spirit for both us and the planet.

Yes, microbes can make us sick too. When we have a lack of balance in our bodies, our immune system suffers. In such a case, we can become sick from the overgrowth or infection of a microbe.

❖ **Scientific and Mystical Answers to the Question: What Is a Virus?**

○ **The Science**

Of course, there is one particular virus we are all thinking about today: the virus that causes COVID-19!

But what exactly is a virus? How is it different than a bacterial cell, a microscopic fungus, or microscopic algae? A virus differs from a bacterial cell in significant ways, in spite of the fact that both are microscopic. Viruses are smaller than bacterial cells, and they are inert (lifeless) until they enter a host cell. These same differences apply to viruses when they are compared to microscopic algae and fungi.

- **Size:** Viruses are ten times smaller than bacteria or microscopic fungi and algae.

Bacterial size ranges from 2 to 50 microns (one millionth of a meter, or 10^{-6}), with 75 microns being the diameter of the average human hair. Something at or below 0.02 mm (20 microns) requires a microscope to see. This size can be envisioned as about one-third the diameter of an average human hair.

Viruses are smaller than bacteria and cannot be viewed with the same types of microscopes we use to see bacteria and other microscopic creatures, such as microscopic algae and fungi.

Because of viruses' tenfold smaller size, more powerful microscopes, such as an [electron microscope](#), are needed to give enough resolution for something as small as them.

For a visual reference of the size differences between microbes, please take a look at this [video](#) created by MetaBallStudios (MBS) artisan A. Gracia Montoya.

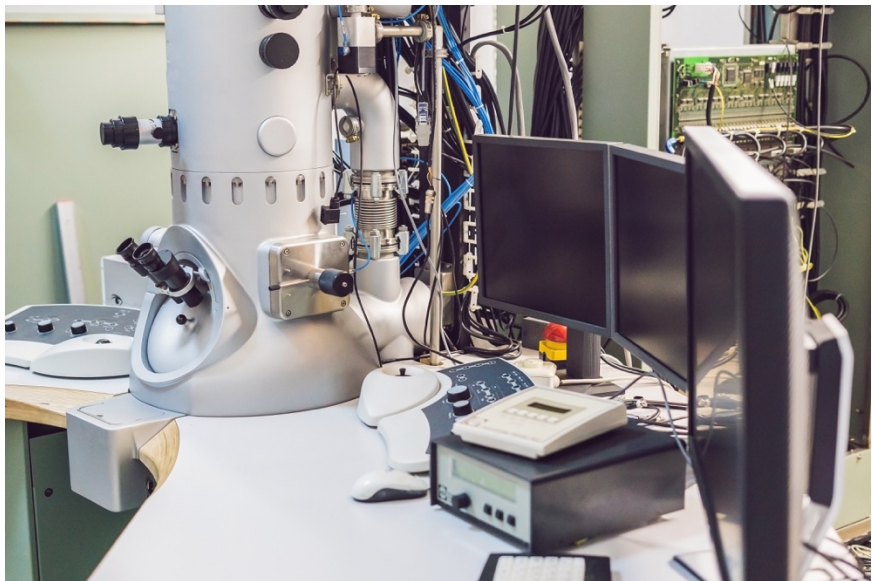


Fig. 11. An electron microscope used to view viruses and other objects that require a higher resolution than a light microscope.

- **They Are Not Alive...or Dead**

Like bacteria, viruses are considered to be microbes. However, they "come alive" after they have hijacked the genetic machinery in a living cell. So the jury has been

out for a long time on whether or not they are considered "living" creatures. For now, I'll use the definition provided by Columbia University virology professor Dr. Vincent Racaniello. He says that there are two phases to a virus. One phase is the nonliving virus particle, the virion, which is the term for the virus when it exists inertly outside its host. The second phase is the living virus, which is the state of the virus after it has infected its host. When the virus has taken over and has forced the host's genetic machinery to relinquish control and to create multitudinous copies of the infective virus, it has "come alive."

- **Virus Nature: An Analogy**

Basically, the nature of the virus can be envisioned as a gold coin slipped into a paper envelope. The "gold coin" is the braid of genetic material, our universal code of life: nucleic acid, also known as DNA or RNA. But most viruses that are known, and the craftiest too, are the RNA viruses. The "paper envelope" is the coat of protein that allows the virus to cloister its "gold coin" until the right pot of solvent, in this case a host cell, is available. Once dropped into a host, the paper envelope is "burned" and discarded. This "gold coin" then uncoils into a single-minded, "Terminator"-like chemical factory. The chemicals in this factory are enzymes. Enzymes are the tools that allow this viral thief to take over the genetic replicating machinery of its host. The virus is the ultimate carjacker. It throws the host cell's driver out into the street and steals the vehicle that was originally designed for the host cell. Now this carjacked genetic machinery is repurposed for the single goal of making millions and millions of replicates of the original virus cell.

That's not all. Because of their small size, viruses have many more generation turnovers than something bigger, like an *E. coli* cell. More generations per time means more mutations. More mutations increase the rate at which Darwinian natural selection occurs, so the virus can adapt quickly to its host cell environment. This advantageous ability of rapid adaptation allows the virus to hop from one host, such as a rat, to another, such as a bat, and then to humans, for example.

Just hopping onto a new host is not enough.

The virus must also endure the onslaught of powerful immune responses in each of these hosts. But once the virus finds the right key to unlock the host cell's security systems, it sheds its coat, bares its genes, and takes over the host's replication machinery to manufacture more viral protein particles. The viral progeny then readily attack and invade other cells in the host.

This hostile takeover of our targeted cells, organs, and limbs is what makes us sick.

In my Microbe Whisperer Aquarium's "Hall of Viruses," the special tank that displays tissues that become the virus's natural habitat will be subdivided so you

can view the human lung tissue during the various stages of the virus entry, establishment, and takeover of this organ.

Other tanks in the "Hall of Viruses" contain models of other organs and systems that are also infected during the course of the viral infection's influence. Read more about the use of miniorgans by medical researchers to learn how [COVID-19 infections affect human organs](#) by going to the link shown here.⁵

- **The Mystical**

To listen to the voices of the Virus Spirit Guide, and to ask for its guidance, means to tune into its nature. Viruses in the natural world will manifest in a similar form on the spiritual plane. The spiritual plane is that place where our consciousness melds with the universal creative flow that runs through all matter. It is on the spiritual plane that we can meet the Virus Spirit Guide and hear what it has to say. By employing the Microbe Whispering approach, you are using a multifaceted perspective on how to view and understand our fellow planetary dwellers, no matter how "invisible" to our eyes they may be.

- **Virus Whispering**

So, what exactly does "Microbe Whispering" to a virus involve? It means understanding the biological nature of the virus.

If you recall from basic biology, base pairs are the alphabet of DNA, and three of these base pairs make a gene that codes for amino acids. Amino acids are the building blocks of protein. Since we are big—so much bigger than viruses—it takes a lot of genes to code for all the different types of protein that make all of our body parts. Genes must code for all kinds of cells, from eyes to liver and hair to toes!

In fact, we humans have 6.5 billion base pairs in our genome to code for all this stuff, not to mention the proteins that make up our enzymes and hormones that keep our living bodies running like well-oiled machines (if you eat right and take care of your health, of course).

The tiny, invisible-to-the-naked-eye virus is a microscopic fragment of protein with a single strand of nucleic acid for its genome. The size of the novel coronavirus genome ranges from 26,400 to 31,700 base pairs. This makes its genome a mere 0.00049 percent the size of our human genome. And of course, physically, we are orders of magnitude larger than a virus, so we really don't give them much thought until they sicken us or the organisms around us. We notice viruses when our forests thin out, our food supply is affected, or our beloved pets get sick from a viral-borne illness.

- **As Microbe Whisperers**, you are viewing and learning about microscopic organisms in their natural habitat. By seeing what they do and learning their specialized ways of feeding, defending themselves, and reproducing, you can learn lessons from them as spirit guides. Just as you would learn lessons about how rabbits, deer, or eagles employ strategies to thrive in the fabric of our Mother Earth, you can do this with microbes. Provided that you can observe them as you would these larger animals, using my Microbe Whisperer Aquarium, you can absorb their wisdom.

- **Cyanophage Teaching—Card #5 in My Pipette Suit**

I used my Microbe Whisperer Card Deck to give me some insight on the essential messages I need to convey with this booklet on Microbe Whispering to the COVID-19 virus. The card deck contains original artwork, rendering forty-four microbes that are good for our environment. I intuitively chose a card, and this card showed the Microbe Spirit Guide that had a teaching to reveal in answer to my question.

My question to the guides in my card deck was: Which Microbe Spirit Guide has a message to convey about the current COVID-19 crisis on our planet?

The Microbe Spirit Guide that appeared in response to my question was **Card #5 in my Pipette suit.**

This card depicts the cyanophage. This cyanophage is a virus that infects and kills blue-green algae.

Fig. 12. #5 Cyanophage (sigh-AN-oh-fage) from the Microbe Whisperer Card Deck.



Cyanophage

Clever Jack equipped with
syringe.

Taking shots at toxic blooms
hitchhiking.

The word "phage" means "eater," originating from the Greek verb *phagein*, "to eat."

"Cyano" is also derived from a Greek word, *kuan(e)os*, meaning "dark blue."

◇ **BGA**

Blue-green algae (BGA) are really photosynthetic bacteria. Too much pollution in a waterbody, such as a pond or a lake, leads to the phenomenon of eutrophication, the overgrowth of BGA. Eutrophication happens either naturally over centuries as lakes age and are filled in with sediments or due to human activities. Some of these activities include the oversupply of nitrogen and phosphorous from agricultural fertilizers and sewage. The overgrowth of BGA siphons off the oxygen for other life in the waterbody and ruins the water too. Blue-green algal blooms can also be toxic to us and other forms of life.

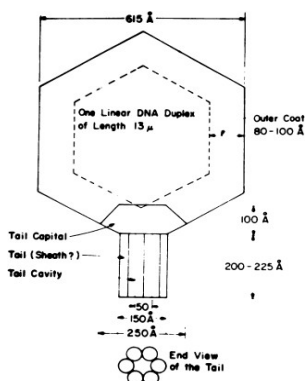
So it is a good thing that the cyanophage exists, right? It kills off this BGA overgrowth.

The cyanophage provides ways for us to learn from other microbes on how they survive attacks from their own viruses: the phages.

Examining how the cyanophage itself works, in infecting BGA, prepares us to more objectively view how the SARS-CoV-2 virus affects us. We can approach the observation of phage and virus the way a visitor would observe these in the "Hall of Viruses" at my Microbe Whisperer Aquarium.

The cyanophage is a Microbe Spirit Guide for our times. Let me share the excerpt from my Microbe Whisperer Guidebook to help explain why.

Fig. 13. Cyanophage shape and size. (\AA = angstroms or 1×10^{-10} M)



How It Eats

The cyanophage uses the metabolism of its host cell to grow and reproduce. It attaches to the host cell and injects its DNA into the host, and the DNA from the phage integrates into the host cell's genome, while the capsid and tail fall off the surface of the host cell, discarded. The phage cell, when it is in its "lytic mode," takes over the host cell's genetic machinery and uses it to make the enzymes it needs to assemble its own progeny: proteins for the head, the tail, and, of course, the phage genetic material. When these progeny phages are ready, the host cell is lysed, releasing new cyanophage particles ready to infect new host cells.

Hidden Menace

Sometimes, the cell will become "lysogenic," which means it doesn't take over the host cell's genetic machinery right away, but instead allows itself to be replicated when the host cells divide. It spreads itself that way in the host population before an environmental trigger, such as starvation conditions for the host cell, causes it

to begin its lytic cycle. **This makes the virus a "hidden menace" as it lurks within a host and its population for many years, passing from generation to generation as it stays hidden inside the host's genome.**

What It Does for the Environment

Cyanophages play an important role in the cycling of nutrients and the population of cyanobacteria in the environment and as a result are integral to marine and lake ecosystem processes. Toxic cyanobacterial blooms in freshwater lakes, rivers, and streams are affected by cyanophage activity, and work is being done to determine how cyanophages might change the abundance of cyanobacteria in fresh water. Particularly, understanding what triggers cyanobacteria to enter the lytic cycle and thus lower the concentration of toxic cyanobacteria such as *M. aeruginosa* could help in the development of using cyanophages as a biocontrol agent in reducing toxic cyanobacteria in fresh water and in the ocean.

Spiritual Significance

Cyanophage is a hitchhiker that may or may not carjack its victim after it's gotten its hands on the wheel. And once inside, cyanophage will use all its victim's resources to serve its purpose, leaving the car and the victim abandoned after it's done. This phage is ancient, having been around as long as its target hosts, the cyanobacteria, so it has plenty of molecular tricks up its sheath.

The cyanophage's entire body is designed to inject and infect a host solely for the purpose of appropriating all of the resources it doesn't have for itself. Its construction is geometric, elegant, functional, and deadly to its host. It's a minimalist when it comes to genetic material too, packing with it only the genes that the host cell will not have, such as the genes for infection, and commandeering the genes on the host cell for most of its reproductive needs. Sure, if you and I were cyanobacteria, this cyanophage would be considered a top enemy, and it would have a negative connotation as an animal guide too. However, as humans, we are susceptible to toxic cyanobacteria that might affect our fresh water and seafood. So cyanophages are really our helpful medicine guides, as they are our tiny defenders from the blue-green algae that can harm us.

The cyanophage medicine guide teaches two sides of survival in the wild by being either the victim, like their blue-green algae targets, or the protected ones, which would be us!

I will provide a summary of the cyanophage's teachings from my guidebook here:

Card Meaning

1. Perfectly designed for a specific purpose
2. Cleverly timed hostile takeovers
3. Ancient ways of exploitation

4. Attracted to those who harvest light
5. Protecting others from harmful disease
6. Geometric, elegant, and functional constructions⁶

The characteristics numbered one to three and six are true for most viruses and phages (bacterial viruses). Number four pertains to cyanophages specifically, because these attach to photosynthetic bacteria, the blue-green algae. And five is interesting. Yes, it applies specifically to cyanophage, because cyanophages kill BGA, some of which cause toxic blooms and can sicken animals and us and taint our drinking water. So in this way, cyanophages protect us from harmful disease. The second interesting aspect of number five is the fact that phages are being developed by medical scientists to treat bacterial infections in humans.

The other lesson of the cyanophage is this: We can choose to become the victors over this virus, rather than be victimized by it. So we can also learn from the "victim." By observing the strategies that blue-green algae (the victims) use to protect themselves from the cyanophage, we can also learn. And in this way, we can apply those lessons to the development of a vaccine against the virus.

◇ **Phages for Medical Use**

Phages are used medically as a means of treating bacterial infections in humans and other mammals. This method has been known and used for at least 100 years. This medical treatment is called phage therapy.

Phages are used medically to combat infections involving antibiotic-resistant bacteria and to target bacteria when antibiotics are contraindicated. For example, a patient might have allergies, irritable bowel problems, or overexposure to antibiotics, thus necessitating an alternative type of treatment.

Phage therapy is a safe application of phages because phages specifically infect bacterial, not mammalian (or human), cells. Naturally, we don't want them to go after the "good bacteria" in our gut. But just as there are many species of bacteria, there are thousands of viruses that are "custom-made" for their particular bacterial host. With carefully designed studies, development of phage treatments is safe and specific, and it targets only the pathogenic bacterium.

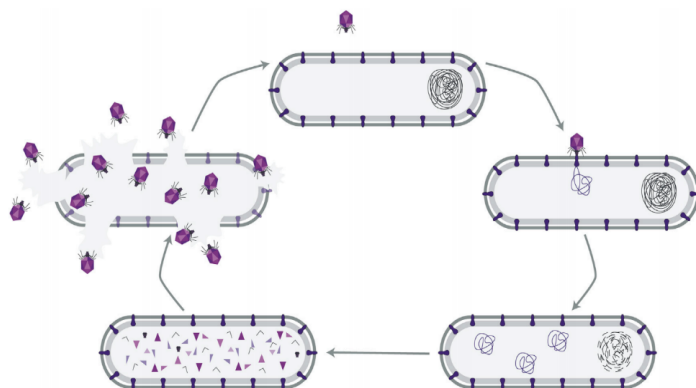


Fig. 14. This illustrates a phage replication cycle as it 1) attaches to the bacterial cell by binding to a receptor on the cell surface, 2) pierces the bacterial cell membrane and injects its viral DNA, 3) takes over the bacterial cell DNA machinery to make its own protein subunits, 4) assembles its subunits to make many copies of itself, and 5) releases its phage progeny out of their bacterial host cell incubator, ready to infect new bacterial cells!

EARLY USE:

Phages were discovered independently by two microbiologists: Frederick Twort in 1915⁷ and Félix d'Hérelle in 1917.⁸ Twort was the first to observe and describe the effects of a “transparent material” that inhibited bacterial growth in 1915. Two years later, in 1917, d'Hérelle isolated a parasite of the *Shigella* microbe and proposed the idea of calling the obligate parasite of bacteria a bacteriophage or “bacteria-eater.” Brilliantly, d'Hérelle recognized the therapeutic potential of phages as a treatment for bacterial diseases. In 1919, he successfully used phages to treat chickens infected with *Salmonella gallinarum*.

In early medical uses, phages were used to treat bacterial dysentery. These studies were conducted by d'Hérelle at a hospital in Paris in 1919 under the clinical supervision of Professor Victor Henri Hutinel, the hospital's chief of pediatrics. The patient's symptoms ceased after a single administration of d'Hérelle's antidysentery phage, and the patient was fully recovered within a few days. Later, in 1921, phages were also used to treat infectious diseases in humans by British microbiologists Richard Bruynoghe and Joséph Maisin, who used bacteriophages to treat a staphylococcal skin disease.⁹ D'Hérelle and others continued studies of the therapeutic use of phages, and d'Hérelle used various phage preparations to treat thousands of people with cholera and/or bubonic plague in India. In addition, several companies began active commercial production of phages to use against various bacterial pathogens.

This was great for a few decades, but then a microbiologist named Fleming discovered penicillin.

➤ **Age of Antibiotics**

After antibiotics and antibiotic development were discovered, phage treatments for bacterial infections dropped off. Alexander Fleming discovered penicillin in 1928, and Western medicine swung into widespread use of antibiotics.¹⁰ But in the 1940s, Fleming himself warned that misuses of these drugs could result in antibiotic-resistant bacteria.¹¹ He was right.

Reports of antibiotic resistance followed, such as the evolution of resistant *Mycobacterium tuberculosis* in early clinical trials for streptomycin efficacy in treating tuberculosis.¹² In spite of this, the discovery and development of novel antibiotics flourished for many decades.¹³ Later in the twentieth century, antibiotic discovery slowed, and the alarming increase in rates of antibiotic resistance signaled that the golden age of antibiotics had perhaps ended.¹⁴ Only three new drug classes were discovered between 2005 and 2018, and no novel drug classes have been developed since the 1980s.¹⁵ In 2017, the World Health Organization (WHO) highlighted the particular threat of gram-negative pathogens resistant to multiple antibiotics. So the discovery, design, and development of new and alternative antibacterial therapies are crucial if we are to survive the onset of new bacterial infections in this century and beyond.

CURRENT USE:

Given the overuse of antibiotics and the development of antibiotic-resistant infectious bacteria, phage therapy is making a comeback. There are many examples of the reemergence of phage therapy. Here are a few examples.

⇒ **Systemic Infections**

Systemic infections are **infections** in the bloodstream. Phage therapy has shown promising results in treating systemic infections that are bacterial.

This has been worked out with animal models (mice) of *P. aeruginosa* and *Staphylococcus aureus* infections.^{16,17} In a systemic disease model of *Vibrio vulnificus*, successful control of the disease was achieved in an animal model only when the bacterial infection and phage treatment were administered simultaneously.¹⁸

⇒ **Local Infections**

Phage therapy for localized infections (e.g., otitis, urinary tract infections, infected burns) is recognized for its potential to entirely circumvent the use of chemical antibiotics.

⇒ **Gastrointestinal Infections**

Phage therapy can be used to treat gastrointestinal bacterial infections. This approach might reduce or prevent the colonization of virulent bacteria without disrupting the natural gut flora.¹⁹

Here is where to get more information on new phage therapy: [PHAGE THERAPY](#).²⁰

◇ **Victim or Victor?**

Microbes are both victims of and victors over viruses. This is their lesson: to remind you and me that we have been victors over viruses too, both those that tried to kill or sicken us and those that failed.

○ **Our Victories**

Our human history is aglow with victories born out of our human ingenuity and our medical innovations.

We have managed to develop vaccines against viruses, such as smallpox, and antibiotics against bacteria, such as the one that caused the cholera epidemic.

Here is a color illustration that names some of the many plagues that have influenced the rise and fall of civilizations.

Fig. 15. Images of bacterial and viral plagues that have influenced the rise and fall of civilizations in human history.



Humanity has certainly endured and emerged victorious over a multitude of viral and bacterial plagues. And alongside this history, we have heroic scientists, healers, mystics, and medical doctors who have provided us with cures and preventative knowledge.

For example:

There have been seven cholera pandemics in recorded history. This table illustrates the date and locations of the cholera pandemics.

Number	Date	Affected Locations	Cause and Cure
First	1817–1824	India; China; Indonesia; Caspian Sea	Cause: <i>Vibrio cholerae</i> (bacteria) fecal-oral transmission via food or contaminated water Cure: Oral hydration
Second	1829–1837	Russia; Hungary; Germany; Egypt; United Kingdom; France; North America	Cause: <i>Vibrio cholerae</i> (bacteria) fecal-oral transmission via food or contaminated water Cure: Oral hydration
Third	1846–1860	Russia; Mecca; United Kingdom; North America	Cause: <i>Vibrio cholerae</i> (bacteria) fecal-oral transmission via food or contaminated water Cure: Oral hydration Prevention: Improved sanitation, water purification
Fourth	1863–1875	India; Mecca; Russia; Europe; Africa; North America	Cause: <i>Vibrio cholerae</i> (bacteria) fecal-oral transmission via food or contaminated water Cure: Oral hydration Prevention: Improved sanitation, water purification
Fifth	1881–1896	Europe; Americas; Japan; Persia; Egypt	Cause: <i>Vibrio cholerae</i> (bacteria) fecal-oral transmission via food or contaminated water Cure: Oral hydration Prevention: Improved sanitation, water purification
Sixth	1899–1923	Russia; Ottoman Empire; Philippines; Mecca	Cause: <i>Vibrio cholerae</i> (bacteria) fecal-oral transmission via food or contaminated water Cure: Oral hydration Prevention: Improved sanitation, water purification
Seventh	1961–1975	Indonesia; Pakistan	Cause: <i>Vibrio cholerae</i> (bacteria) fecal-oral transmission via food or contaminated water

			Cure: Antibiotics Prevention: Improved sanitation, water purification
--	--	--	--

Table 1. Major cholera pandemics in recorded history.²¹

In 1854, during the third cholera outbreak, physician John Snow (1813–1858) made a major contribution to fighting cholera. He did this by demonstrating a link between cholera and the contaminated drinking water by carefully mapping the deaths from the disease and correlating them to a specific water pump. Snow made the connection between sewage in drinking water and the cholera outbreak. Thanks to John Snow and others who followed, England began purifying drinking water, curbing and finally ending cholera outbreaks by implementing improved sanitation.

Due to the brilliant work of many thoughtful healers, scholars, and medical practitioners, several ways of preventing smallpox were developed, including an early version of a vaccine called variolation. Variolation consisted of scrubbing off the lesions on those infected with smallpox and introducing them into the body of an uninfected person. This appeared to give the recipient an amount of immunity to smallpox in many cases and decreased the death percentage of the disease in a population treated this way.

In earlier time periods, pandemics gave rise to many spiritual and folkloric cures. As humanity became more educated on the existence of microorganisms, thanks to thousands of scientific laborers, we developed antibiotics and vaccines to combat infectious diseases.

○ **Our Future Victories**

As we build upon decades of scientific knowledge in many different cultures, we are accumulating a larger, more sharpened, and targeted set of molecular, biochemical, and medical tools. These tools will be used to create protections from new infectious diseases in our present and future generations. Right now, let's look at how our current tools will help us curb the 2020 pandemic.

❖ **The Coronavirus Pandemic 2020**

In December 2019, another pandemic was added to the history of our planet as a case of pneumonia was identified in Wuhan, Hubei Province, People's Republic of China (PRC).²²

The causative agent of this pneumonia was unknown. In an age of advanced medical science, the fact that the agent that caused this first case in China was not one that could be identified was bad news.

First, a serious disease caused by an unidentified infectious agent left medical care practitioners shooting in the dark to try to cure the patient. Second, since the disease was unknown, the method by which others could become infected, as well as the level of infection and the lethality of this disease, was unknown.

But the Chinese experts at this hospital in Wuhan were able to quickly apply scientific analysis to characterize and isolate the cause of this novel coronavirus pneumonia. By January 2, 2020, body fluids were collected from forty-one subsequently admitted patients who complained of pneumonia that had an unknown cause. Molecular tools were applied (real-time PCR and next-generation sequencing), and the common infectious agent in these patients was identified as a new coronavirus.²³

This virus was reported to be a member of the "b" group of coronaviruses.

The novel virus was named the Wuhan coronavirus or 2019 novel coronavirus (2019-nCoV) by the Chinese researchers. The International Committee on Taxonomy of Viruses (ICTV) named the virus as SARS-CoV-2 and the disease as COVID-19.²⁴

Naming the Virus

Viruses are named based on their genetic characteristics. This is important, as it eases scientific communication about the disease across countries and cultures. The 2019-nCoV infection was formally named the COVID-19 disease by the International Committee on Taxonomy of Viruses (ICTV) on February 11, 2020. The virus itself was named SARS-CoV-2 by the Coronaviridae Study Group on the ICTV.

The Coronavirus Family

You may have noticed the word "Coronaviridae" that was tossed into that last paragraph. This is Latin; Latin is traditionally used by biologists in a system of classification for organisms. The way this classification works is shown on this table.

Table 2. Coronavirus classification.

	Virus	Severe Acute Respiratory Syndrome Coronavirus (SARS-CoV)
Ranks	Species	Severe acute respiratory syndrome-related coronavirus
	Subgenus	Sarbecovirus
	Genus	Betacoronavirus

	Subfamily	Orthocoronavirinae
	Family	Coronaviridae
	Suborder	Cornidovirineae
	Order	Nidovirales
	Subclass	
	Class	
	Subphylum	
	Phylum	
	Subkingdom	
	Kingdom	
	Subrealm	
	Realm	Riboviria

Coronaviruses belong to the Coronaviridae family in the Nidovirales order. "Corona" refers to the crown-like spikes on the outer surface of the virus; thus it was named coronavirus.²⁵

Coronaviruses are between 65 and 125 nm (nanometer = 1×10^{-9} m) in diameter, and they contain a single-stranded RNA as a nucleic material with sizes ranging from 26 to 32 kbs (kilobases = 1000 base pairs) in length (Fig. 16).

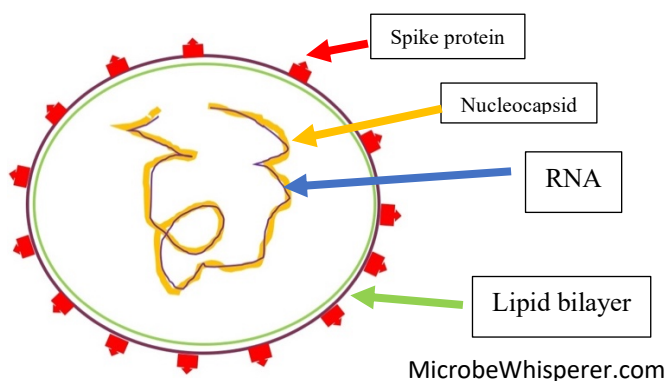


Fig. 16. Structure of respiratory-syndrome-causing human coronavirus.²⁶

The RNA material is found inside the virus and acts as a template for enzymes to convert it first to DNA, then to messenger RNA, and then to protein molecules that create new viruses.

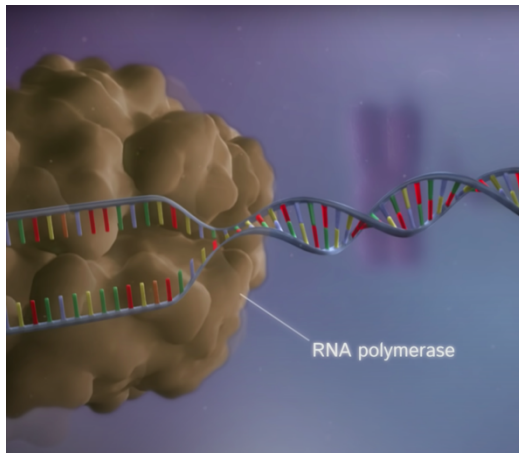
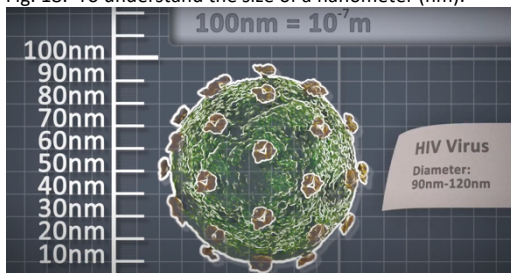


Fig. 17. Transcription of DNA to translation of mRNA (click on image for credits and video).

If you want to learn about how DNA is transcribed to messenger RNA (mRNA) and how mRNA is translated into the amino acid chains that make proteins, please click on Fig. 17 for an informative animation of the subject.

Fig. 18. To understand the size of a nanometer (nm).



For an understanding of the size of a nanometer, a nm is 1×10^{-9} of a meter. Fig. 18 shows a size chart beside an image of the HIV virus.

There are subgroups in the coronavirus family too. These are called by the Greek letters: alpha (a), beta (b), gamma (c), and delta (d).

It's important to know the relationship of COVID-19 to other members of its family because this helps scientists (both clinical and academic), as well as medical professionals, better understand this tiny, relentless pillager.

The three human coronaviruses (CoVs) that have been identified so far are the Middle East Respiratory Syndrome coronavirus (MERS-CoV), severe acute

respiratory syndrome coronavirus (SARS-CoV), and the 2019 novel coronavirus (2019-nCoV), as previously termed by the World Health Organization (WHO)

Our main goal right now, as the ravaged population of hosts in 2020, is to curb the 2019-nCoV virus's lethal scourge through the lungs of humanity.

The severe acute respiratory syndrome coronavirus (SARS-CoV), H5N1 Influenza A, 2009 H1N1, and Middle East Respiratory Syndrome coronavirus (MERS-CoV) cause acute lung injury (ALI) and acute respiratory distress syndrome (ARDS). These particular viruses were previously thought to only be infectious to animals other than humans. But then we had a severe acute respiratory syndrome (SARS) outbreak caused by SARS-CoV in 2002 in Guangdong, China.²⁷ Then, a decade later, in 2012, another pathogenic coronavirus known as Middle East Respiratory Syndrome Coronavirus (MERS-CoV) caused an endemic in Middle Eastern countries.²⁸

The disease agent for COVID-19 first emerged in Wuhan in December 2019. There, in one of the most crowded transportation hubs of China, the outbreak of a novel coronavirus killed more than 1,800 and infected over 70,000 people within the first fifty days of the epidemic. And the virus proceeded from that epicenter to cut its wide-ranging swath of infectivity and death throughout the human world. By 2020, this had changed the face of our globe. As we peer over our now-masked faces, we have viewed our new normal in mass disbelief, fear, anger, confusion, and then acceptance as the outbreak of SARS-CoV-2 officially became recognized as a pandemic in March 2020.

5 - How Does the Novel Coronavirus Attach to Our Bodies?

The Scientific and the Mystical

The Science

You are able to understand and observe the migration of monarch butterflies or geese from one continent to another. By analogy, I want to offer a similar vantage point in observing the migration of a virus from animal species to animal species and to humans (we are mammals).

An infection that can jump from an animal host to a human being is called a zoonotic infection.

The microbe responsible for this type of infection can jump hosts through direct contact, from food, or from insect bites, such as those from ticks and mosquitoes.²⁹

Bacterial and viral zoonotic infections are numerous, and there is an ever-expanding list of pathogens that can affect humans. Just as numerous are the widely varied ways that transmission of these pathogens to humans occurs.

We are fortunate that in the current state of scientific advances, scientists have at their fingertips sophisticated molecular biology tools that allow them to pinpoint the origins of a virus. These molecular biology tools let scientists specifically identify the "fingerprint" for the ancestral lineage of something like a virus or bacterium. With these tools, we can be certain that the recent SARS-CoV-2 was transmitted from bats to humans. More information on how this is done is explained by the lecture linked to Fig. 19.

(Click on the image to be directed to the lecture video.)

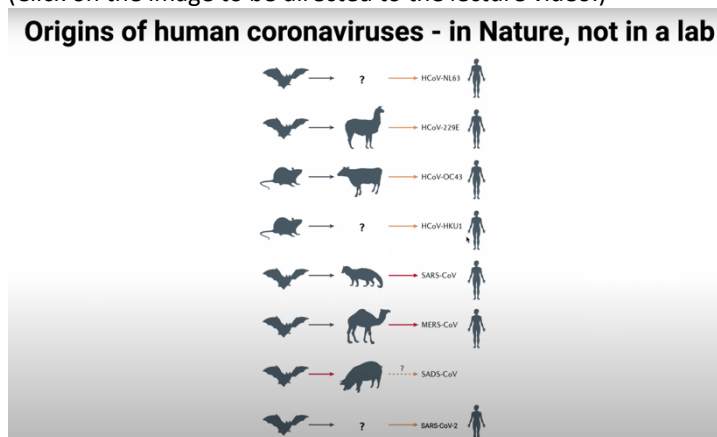


Fig. 19. Shows the animals identified as the reservoir hosts for the transmission of a coronavirus to humans.³⁰

As shown in Fig. 19, this most recent pandemic is not the first time that a virus has made the jump from animal to humans and become widespread. For example, the avian H5N1 influenza virus originated from birds. And our COVID-19 pandemic is not even the first time a coronavirus has made that zoonotic transmission to human, as shown in Fig. 19 above.

The SARS-CoV that emerged in November 2002 in Guangdong, China, originated from animal hosts: bats, palm civets, and raccoon dogs. And its "key" for entry into

human host cells matched same "lock" as for our current COVID-19 virus. Just like SARS-CoV-2, SARS-CoV also uses the ACE2 receptor to unlock its human host cells.

The MERS coronavirus first emerged in 2012 in Saudi Arabia. MERS-CoV is also a (b) betacoronavirus, with camels as a zoonotic source or primary host. But in a recent study, MERS-CoV was also detected in bats.

Infections transmitted from animals to humans can come from either domestic animals or from wildlife. And the transmission can be indirect, such as those by vector-borne diseases, some of which are introduced into humans via tick and mosquito bites.

Climate Change

Climate change also plays a key role in the increase of pathogenic agents transmitted from animal hosts to humans. Infectious disease exchange between humans, wildlife, and domestic animals is affected by many interwoven environmental factors, including pollution, waste management, vector ecology, urban microclimates, and human encroachment on wildlife habitats. The impact of humans on ecosystem health is complex.

Our response to climate change and the decrease in biodiversity that results from this change will influence the amount of infectious diseases and pandemics that will emerge in the future.³¹

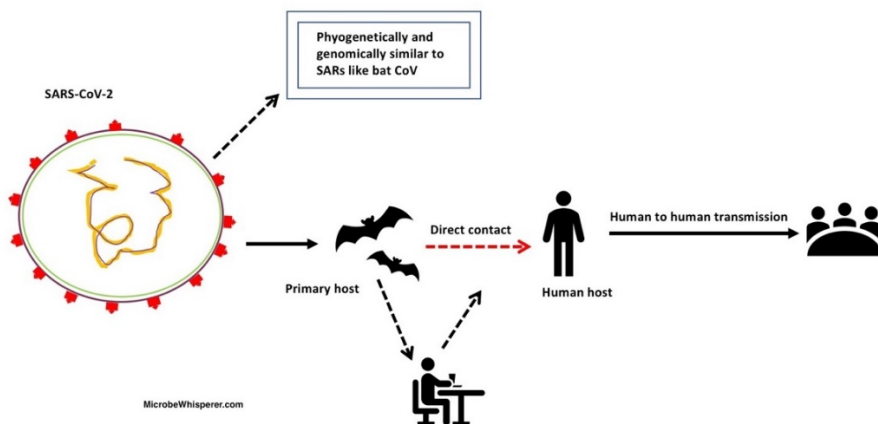


Fig. 20. This diagram summarizes the current state of knowledge on how humans may have contracted the virus that causes COVID-19.³²

Human to Human

Viruses travel on air droplets. These come out of our mouths whenever we exhale and enter us when we inhale. When the virus reaches a high enough concentration, or "titer," it is able to beat the odds, and at some point one of the millions of virus particles makes contact with the right cells in our bodies that have the right "lock," or receptor, for their particular chemical "key."

To have a better understanding of how the novel SARS-CoV-2 virus enters, attaches to, and infects human beings, let us first get an overview of a virus that attacks warm-blooded creatures, like mammals. I have already described phages, the type of virus that affects bacterial cells.

Phages, as stated above, can be viewed as gold coins stuffed into an envelope: i.e., genetic material encased by a protein shell. All a phage has to do to infect a bacterial cell is attach itself to the bacterial cell's outside skin (membrane) and inject its genome into the cell. Then the virus can get to work, hijacking the bacterial cell's protein-making machinery and becoming enslaved by the virus to become that virus's own manufacturing plant.

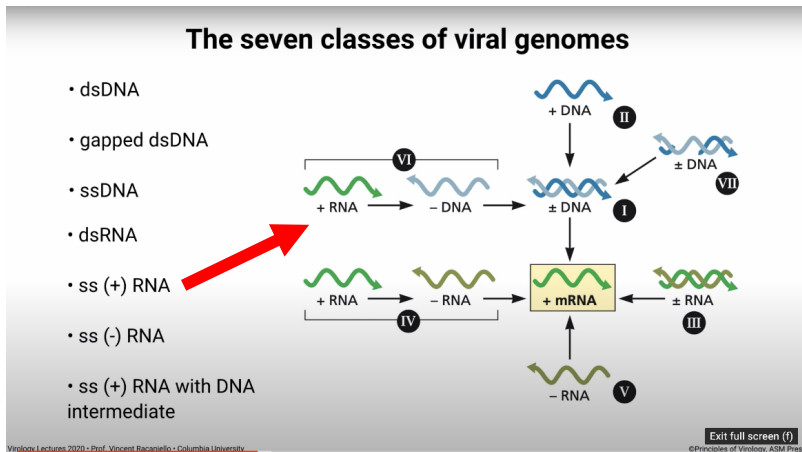
But the virus that infects a warm-blooded creature, such as a bat, bird, or human, has to create a more sophisticated strategy, due to the increased barriers that vertebrates have against viral invasion.

The animal virus has an extra coat over its protein shell. This coat is studded with proteins that are designed to trick the host cell into giving up its immune defenses, to let it into the host cell's inner chambers, where the nucleus and main genetic machinery for the host cell is sequestered.

There are thousands of types of animal viruses. The image below shows a small example of how they vary in shape and size. They are categorized into seven simple classes.

These classes are called the Baltimore categories. The seven classes are based on the types of DNA or RNA that the virus harbors: the "gold coin" in my analogy.

Viruses are classified under a system called the "Baltimore classification." There are seven of these categories in the system. They are shown in Fig. 21.



The CoV-2 virus belongs to the (+) RNA type of virus. This type of virus has the highest rate of mutation. In molecular biology terms, genes mutate at the rate of once every one million times. And all genes are susceptible to mutation. We have powerful enzymes that repair these mutations so that they do not cause too many genetic defects when we are born.

In biology, the higher the generational turnover rate for an organism, the more mutations can effect an observable evolution. This means that we can see bacteria and viruses evolve faster than, say, a rat, because the generation time is short for these microscopic creatures, like the bacterial cell and the virus. Mutations are what allow for the development of traits that give the organism better chances for survival. And better chances of survival mean that the organism can pass these stronger traits to their progeny.

For a rat, a better survival trait might be a fur coat that blends more easily in its natural environment. If a white rat and brown rat were hiding from predators in the bush, most likely the white rat would be seen and eaten. So more brown rats survive, passing this brown coat color to their offspring. However, if the terrain is snow-covered, then of course the brown rat would stand out and it would be the white rat, which is easily camouflaged in the snow, that would survive predation.

ACE2 Receptors

Remember that discussion about whether or not a virus is considered a living organism?

When it is in its inert, nonliving phase, the virion is traveling free, flying within droplets from the breath of its last host or ducking inside an aqueous microniche

within a speck of soil on the ground. It might also be swirling inside water drops on the leaf of a tree or lurking within a moist crevice on surfaces in your home.

When the virion particles reach a certain density—that is, when their concentration is high—then there is enough of the virion load (called a titer) to become infectious. This is because the probability of some of these virion particles entering a host orifice are statistically higher. Furthermore, once inside the host, the higher the virion titer, the more likely it is that some of these virions will encounter the right lock on the host cells for their keys to turn the lock and open the door to the inner chambers of these host cells. Once inside, the virus carries its nucleic material to the right location inside the cell for the next stage of its infectious cycle: taking over the host cell's protein-making machinery.

SARS-CoV-2 is an inert virion until it encounters a host cell. But finding the right host cell is not enough for this virus to cause a cycle of infection. This host cell must possess the right "lock" for the "keys" on the surface of the virus. This "key" that is specific to its host cell is situated on the "spike" part of the virus's outer coat (see Fig. 22).

This "spike protein" is what the virus uses to recognize a specific "lock," called a receptor, on the surface of the host cell. In biochemical terms, this "lock" on host cells is called an ACE2 receptor. The "key" on the virus is also known as an "S protein." There is a very specific amino acid on the spike protein of SARS-CoV-2 that matches up with a specific amino acid on the human ACE2 receptor. In biochemical jargon, the spike protein has a 394 glutamine residue that recognizes and binds to the 31 lysine residue on the ACE2 receptor of the human host cell.

Once the right lock fits the key— that is, when virus's S protein binds to the cellular receptor, or ACE2, on the host cell— this SARS-CoV-2 is on its way to becoming a "real live organism."

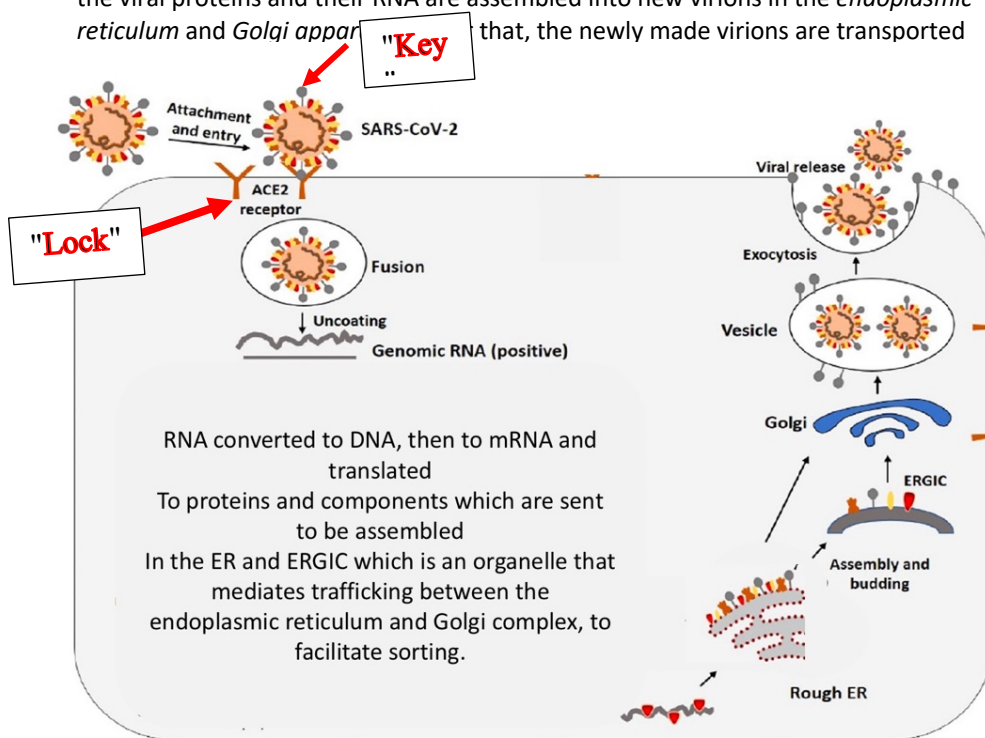
Just a note on the difference between how phages work and how animal viruses work.

The bacterial virus, called the phage, injects its nucleic material (DNA or RNA) directly into the bacterial host, and the rest of the phage body is discarded, as it is no longer needed.

This is because with bacterial cells, there is no nucleus that houses its genetic material (the DNA), so the phage DNA or RNA does not have to cross more barriers to get its host DNA's replicating machinery to work on the virus's own nucleic acid template.

But with animal viruses, there are many layers of barriers that the virus must overcome to get its genetic material to the right section of the host cell: the nucleus and the location of its DNA. The nucleus is where the DNA template is transcribed to messenger RNA and where the protein chains are translated from this mRNA.

After receptor binding, the conformational change in the S protein facilitates viral envelope fusion with the cell membrane through something called the *endosomal pathway*. Then SARS-CoV-2 releases RNA into the host cell. The host cell's enzymes are taken over to enable the translation of the viral RNA into viral proteins. Then the viral proteins and their RNA are assembled into new virions in the *endoplasmic reticulum* and *Golgi apparatus*. That, the newly made virions are transported



The good news is this: Virology theory postulates that viruses evolve to become less lethal to their hosts. After all, by killing their host, they also kill themselves. So the virus population tends to evolve toward its own self-preservation by eventually not killing its hosts.

In the recent past, SARS-CoV (2003) infected 8,098 individuals, with a mortality rate of 9 percent across twenty-six countries in the world. In comparison, SARS-CoV-2 (2019) has infected 16,883,654 people, with a mortality rate of 3.4 percent across 213 countries, as of the date of this writing.

(Mortality rate is defined as the cumulative **current total deaths divided by current confirmed cases**).

As of this writing, the global coronavirus death toll has passed one million.³⁶ Due to SARS-CoV-2's wider spread, its transmission is higher than that of SARS-CoV.

As I stated before, the novel SARS-CoV-2 virus has had to adapt to the selection pressures of moving from one species of mammal to another. In this case, it is believed that the COVID-19 virus migrated from bats to humans.

From molecular genetic analysis, scientists have figured out that the receptors on the bat cell were ideal for this SARS-CoV-2 to take a firm hold in the bat. However, it was a different story for human receptors. At first, the lock and key were a loose fit, having come from a different animal (bat) that had slightly different-looking ACE2 receptors. But then through mutation and natural selection, the virus evolved its "keys" to become a better fit for the ACE2 receptors (the "lock") on our cells. Mutation in a virus happens approximately once in a million copies. This mutation rate is a common trend in all dynamic living organisms.

But a mutation that gives a virus an infectious advantage is not great news for its new host.

There is a comfort in the fact that in virology, the prevalent theory is that viruses evolve toward becoming less lethal to their hosts. After all, by killing their host, they also kill themselves. So most likely, although this virus has become better-adapted to our host cells, mutations that allow the virus to be more lethal are not going to be favored. If anything, the virus may take the path that previous viruses in human history have taken—that of becoming a nuisance, like the common cold, rather than a death sentence. Another possible fate for our current *danse macabre* with the virus might be that we eradicate it completely with a brilliantly engineered knockout vaccine.

What Is Mutation?

I discussed mutations in the previous section, and I wanted to help you build a better understanding of what a mutation is on a molecular level. To understand a genetic mutation, it's useful if you understand how genetic codes in our DNA work.

Gene Codes

First, all life makes copies of itself by using a genetic code. Before Watson/Crick and Franklin showed us that the structure of DNA is a double helix, there was a scientifically curious monk named Gregor Mendel. This monk, through careful and patient analysis, discovered that the basis of our heritage was carried in genes.

While working in his monastery on crossbreeding pea plants between 1856 and 1863, Mendel established the rules of heredity.

But it wasn't until 1953, 100 or so years later, that Watson/Crick and Franklin correctly identified that DNA is shaped like a double helix.

The point of giving you this brief history is to illustrate that it takes many scientists working painstakingly over the course of many centuries to add to our human knowledge database. And I am flying on the wings of these fantastic minds to summarize what we know about how DNA coding works.

First, the genome of an organism, its genetic code, is made up of DNA or RNA.

DNA codes use the chemical molecules, called "bases," that are shown below.

These bases are adenine, guanine, cytosine, and thymine, and are abbreviated A,G, C, and T.

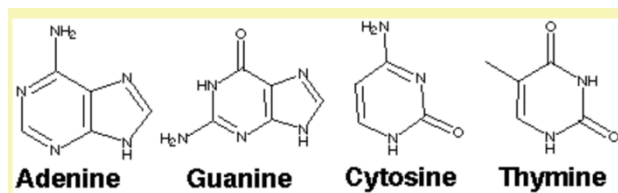


Fig. 23. The bases for DNA.³⁷

It is these four bases that form base pairs through hydrogen bonding to create the DNA double helix, shown in this next image.

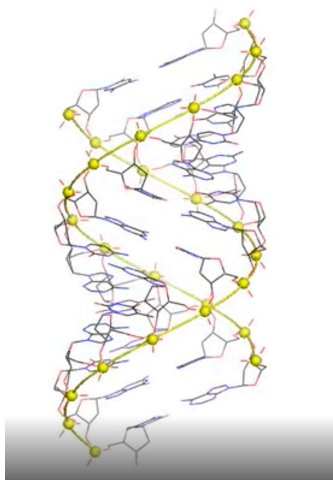
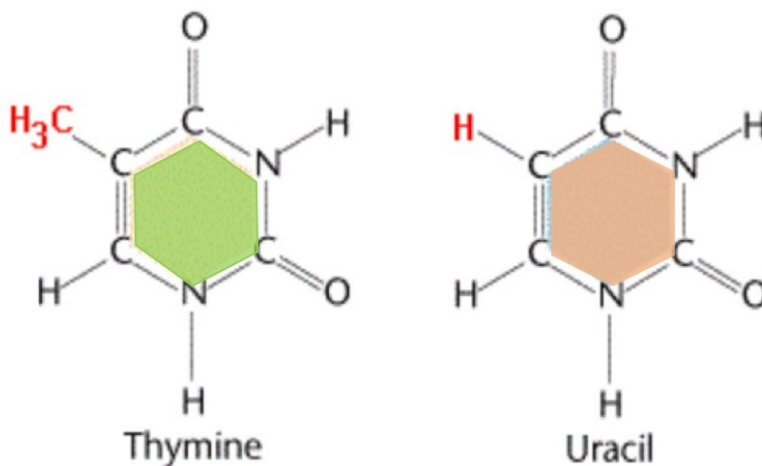


Fig. 24. DNA double helix.

In a DNA double helix, A pairs with T and C pairs with G. But in RNA, instead of thymine, the base called uracil is used. In this image of the structure of the two bases, the letters in red show the chemical moieties that differ between thymine and uracil.

Fig. 25. Thymine base for DNA, uracil base for RNA.³⁸

Because of this chemical difference, RNA does not form a double helix like DNA. Instead, RNA is usually single-stranded. But RNA does fold up and appear in tRNA, mRNA, and rRNA forms, and these special types of RNA are configured to perform special tasks in our cells for the translation of proteins.

The image below shows the differences between RNA and DNA.

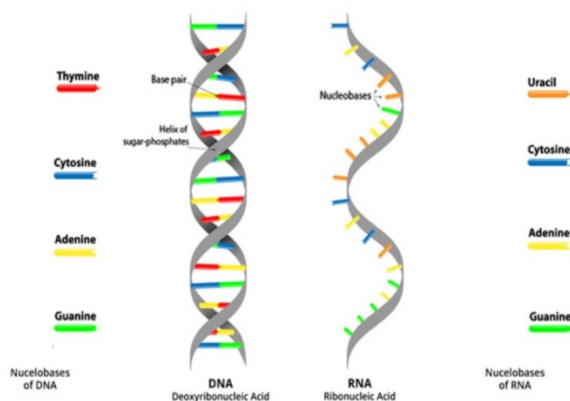


Fig. 26. DNA versus RNA.³⁹

Most organisms, including humans, use DNA for their genetic code instead of RNA. This is because DNA is more stable than RNA. However, all organisms still use RNA for other parts of the biochemical factory that makes our protein. It is viruses that are capable of using either RNA or DNA for their genetic code. This is related to how viruses evolved, which will be covered in another section.

For now, let's see how mutation works.

Mutation Definition

A mutation in a gene means that there is a substitution in the base pairs that code for that gene. This change in a base pair will change how that gene is translated.

The translation of a genetic code involves enzymes, messenger RNA, and ribonucleotides.

A genetic code consists of three base pairs that, when translated, directly correlate to a particular amino acid. Amino acids are the building blocks of proteins. There are twenty-one amino acids. Since not all genes code for amino acids, the genes that specifically code for amino acids have a special name: codon. A codon is a sequence of three DNA or RNA bases that correspond with a specific amino acid during **protein synthesis**. DNA and RNA molecules are written using only the four bases. These four bases in DNA — A, T, G, and C—are converted to messenger RNA, abbreviated as mRNA.

So in the transcription process, when the DNA template is getting "read" by the polymerase enzyme to make mRNA, the "A" from DNA becomes "U" on the mRNA. The rest of the DNA template is transcribed on mRNA as T >> A, G >> C, and C >> G. It is the mRNA that is translated by ribosomes (also made up of RNA) into amino acids.

These amino acid chains fold into the wide array of proteins that we need for life.

Below is a diagram of how amino acids match up to genes. The abbreviations of Met, Thr, etc. are abbreviations for amino acids. The full list of abbreviations for amino acids can be found [here](#). Notice in the diagram below that there is a "U" in the code. This is because the code that matches up to an amino acid is from the mRNA. And as mentioned before, RNA uses the base "U" instead of "T."

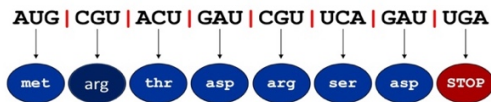


Fig. 27. Codons corresponding to amino acids.

A gene is a set of molecular letters to form what you can imagine as a code. That code is translated by special genetic machinery (enzymes), which corresponds with a protein or acts as biochemical instructions for other genetic tools to perform a task.

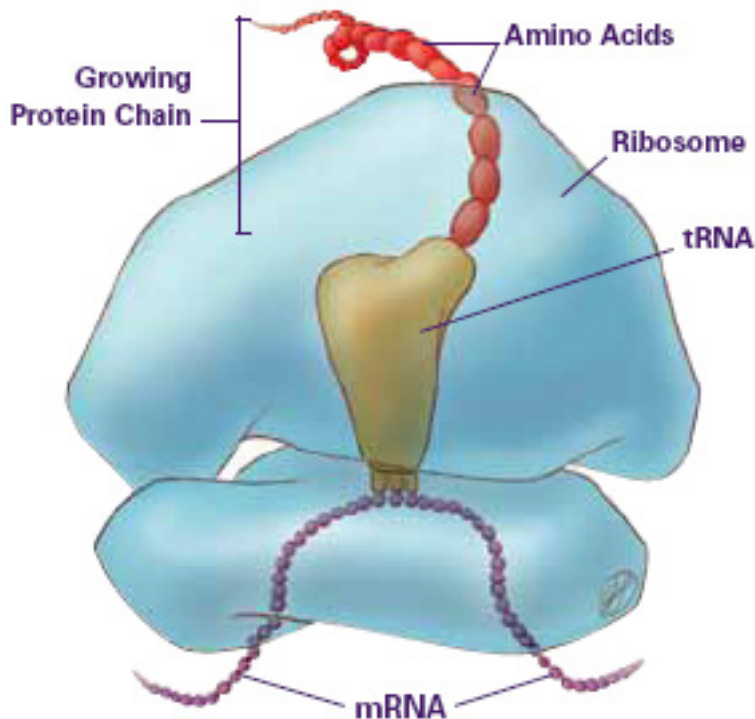


Fig. 28. The translation of mRNA to an amino acid chain, with the ribosome holding tRNA in place.⁴⁰

Translation is the process that takes the information passed from DNA as messenger RNA and turns it into a series of amino acids bound together with peptide bonds.

The steps in translation are:

1. The ribosome binds to mRNA at a specific area.
2. The ribosome starts matching tRNA anticodon sequences to the mRNA codon sequence.
3. Each time a new tRNA comes into the ribosome, the amino acid that it was carrying gets added to the elongating polypeptide chain.
4. The ribosome continues until it hits a stop sequence, then it releases the polypeptide and the mRNA.
5. The polypeptide forms into its native shape and starts acting as a functional protein in the cell.

This type of protein manufacture happens within our nucleus, since we are eukaryotes. But it happens inside a "nuclear" region in cells like bacteria (prokaryotes have no nucleus). And this transcription-translation process happens millions upon millions of times inside a living cell.

You know that there is a such a thing as human error. If you were a human on an assembly line, invariably you'd goof up once in a while and place the wrong piece into the wrong box.

So you can understand that, given that this molecular assembly line involves many repetitive steps by many players, there is also such a thing as molecular error. With so many molecules to keep track of, there is a statistical probability of mutation—which, by analogy, is when an assembly line worker drops a piece or puts the wrong piece in the wrong box.

A mutation happens when the letters in these codons are substituted or deleted. And when the right codon is no longer read, the wrong amino acid or no amino acid is made.

This in turn creates a bad protein, or a nonfunctional protein. Sometimes a mutation creates a protein that gives the organism an advantage over the other organism. Such mutations are carried into the next generation of that organism if such an advantage allows the organism to survive over the others. This is the concept of "natural selection" described by Darwin.

There are traditionally taught examples of how mutation drives natural selection in a population. One is the [Batesian mimicry](#) of moths, white and black, during the industrial revolution.⁴¹

Types of Mutations

There are three types of DNA mutations: base substitutions, deletions, and insertions.

With base substitutions, one base is substituted with another, which ends up coding for the wrong amino acid.

With deletions, a base or two or even entire codons are deleted. With insertions, extra bases or codons are added.

As you can imagine, any one of these can lead to the wrong protein getting made. There are various outcomes from a mutation.

Let me show you by using a sentence as an example.

Original sentence:

We will defeat the virus with our resilience and imagination.

Silent mutation: ("i" missing from "with" does not change the meaning of the sentence)

We will defeat the virus wth our resilience and imagination.

Nonsense mutation

We will defeat...

Missense mutation

We will the with our resilience and imagination.

Frameshift (+1 word)

We will NOT defeat the virus with our resilience and imagination.

Frameshift (-1 word).

We will defeat the virus our resilience and imagination.

Frameshift (+1 word, - 1 word).

We will NOT defeat the virus with our and imagination.

Just as you were able to fill in some of the statement, so can the molecular machinery with some types of mutations. And in some cases, the wrong meaning is derived. In such a case, with genetic scenarios, the wrong amino acid could lead to a defective protein or no protein at all. In humans, it would manifest as a disease or defect. In viruses, it might result in a different type of ACE2 receptor. In some cases, such as the "nonsense" mutation, there may be no protein made or a failed attempt to create one. So that particular protein is not made, and it will have effects on the overall well-being of the organism too. In the case of a virus, it might be created without the proper means to infect its host. Genetic manipulations by scientists could create such a deliberate mutation in an effort to stop the virus from infecting us.

Mutation is what drives evolution and selective pressures. And these are what continue to keep a mutation that is beneficial to the organism.

The novel SARS-CoV-2 virus has had to adapt to the selection pressures of moving from one species of mammal to another. In this case, it is believed that the COVID-19 virus migrated from bats to humans. It is interesting how the coronavirus evolved to have an affinity for our particular ACE2 hormone or "receptor." The virus uses its own glycoproteins (sugars) to help it enter our cells by recognizing

and attaching to our receptors. These ACE2 receptors are part of a system that regulates our blood volume, kidney functions, and cardiac activities. The virus that causes COVID-19 is shown to have migrated from bats to humans, based on current molecular analysis. This makes the virus a zoonotic disease—one that moves from a nonhuman to a human host. Since its first entry into the human population, the virus has mutated from recognizing and attaching to bat ACE receptors. And such mutations have led to it developing an even higher affinity for our ACE2 receptor-coated cells.

Not only does mutation and natural selection play a role in how a virus can become more comfortable in its new host—in this case, a human host—but mutation also helps the virus become a better infectious agent in a number of other ways.

Main ways:

- 1 - It can recognize and better attach its target receptor onto your cells.
- 2 - It can hide from your cellular immune response.

Who Came First?

The virus or the host?

We know that predators have been around since before humans evolved. Before us, carnivorous predators had other prey to eat. So is that true for viruses? If they are inanimate until a host comes along for them to hijack, wouldn't that mean that the host evolved first?

Since bacteria were the first cells to evolve on Earth, would this not mean that they had to come first, before their predator/infectors, the phages?

You might think so. But according to leading experts on evolutionary biology, you'd be wrong.

Remember, viruses have both DNA and RNA. Studies on origins of life have led to the discovery of an RNA that can replicate itself. And this RNA apparently can make copies of itself without protein-based enzymes.⁴²

What this means is that an ancient, lone RNA would have been able to make copies of itself without going through the DNA protein-making factory to make any enzymes.

Eventually, once host cells in the form of primordial bacteria evolved, the lone RNA strands that could penetrate these host cells took over their machinery and coated

their progeny in protein, most likely to improve their chances for survival. This theoretical, replicating, lone RNA is suggested to have been the ancestor of today's RNA viruses.

Since their first emergence billions of years ago, phages have developed a diverse range of sizes, shapes, and host preferences. The examples here are of a T4 phage, which uses *E. coli* as its host, and of a cyanophage (discussed before), which uses blue-green algae as its host. In all these cases, a virus is much smaller than its bacterial hosts.

- **What Do Bacteria and Humans Have in Common?**

Both bacterial and human cells are impenetrable by viruses without the right molecular key.

Bacteria are not easy for phages to enter and convert into protein-making automatons.

And neither are we.

Bacteriophages

Let's talk about the phage strategy first.

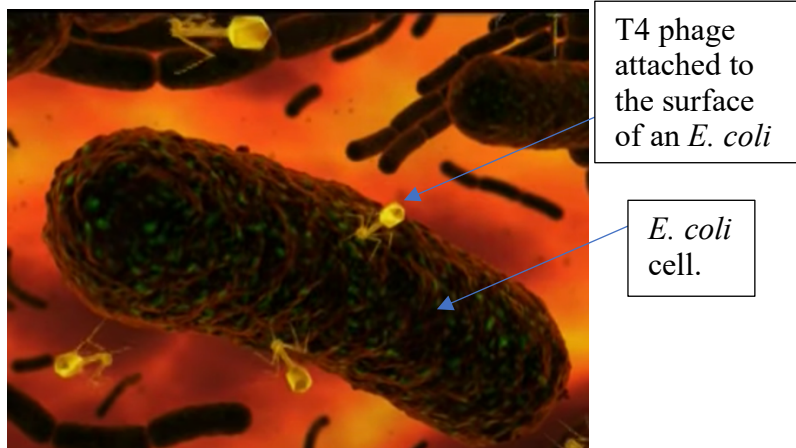


Fig. 29. T4 phage cells attacking *E. coli*.⁴³

A phage is a bacterial virus that requires particular receptors to recognize and "lock on" to the surface of its host bacterial cell. The viruses are equipped with spidery

"legs" that recognize these receptors. Then, once the proper "lock" on the bacterial cell surface is identified, the phage is signaled to deploy hook-like equipment from its base to make an unbreakable bond with the bacterial cell surface. After all this is done and the phage is securely positioned on the bacterial cell, it will inject its genome (DNA or RNA) into the bacterial cell. The rest of the phage body is discarded or degraded by the phage itself. Once the phage's genome is inside the host cell, the cell becomes enslaved to the will of the viral enzymes that convert the cell to their own phage-making factory.

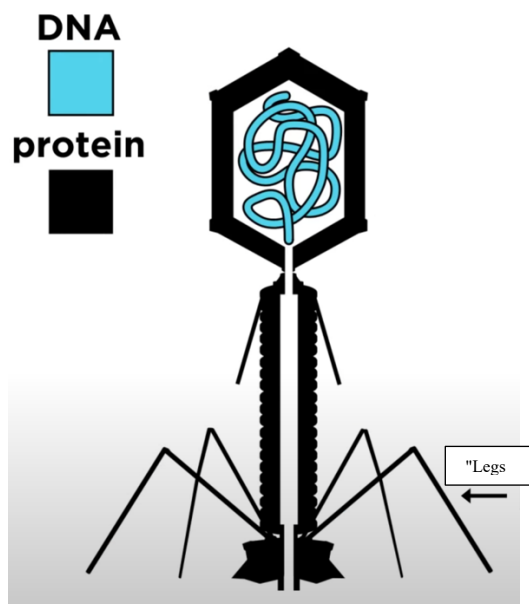


Fig. 30. Diagram of a T4 phage showing the DNA genome and the viral body, designed to inject this DNA into a bacterial host cell.

Since the viruses evolved along with their bacterial hosts, the bacteria have managed to develop resistance to the phage via mutations that are cultivated through natural selection.

Because the virus has a molecular "key" to the bacterial host receptors, or "locks," the strategy the bacterial host cell uses to defend itself from invasion is to change the locks on its "door." The bacterial cell does this by mutation (see previous description of mutation). Of course, these improvements happen over time via natural selection. Those bacterial cells that survive a viral attack may have the appropriately mutated receptor that is harder for the virus to recognize. Such a mutation amounts to changing the lock on the door. However, viruses respond too by getting new keys made via mutation in their genetic codes.

Bacteria and viruses have fast generational turnovers, so it is easy for them to evolve this genetic thrust and parry more quickly than humans can.

Human Evolution

Humans also evolve via mutation, where natural selection pushes our evolution toward survival of the fittest. However, the time it takes for the positive mutations to take hold and have an observable generational effect is many more years than the quick day-and-hour turnaround time of faster-reproducing viruses and bacteria.

Paleontologists can tell us how we have evolved from our ancestors by finding clues to piece together from the fossil record. But given the modern techniques of molecular biology, it is also possible to observe the present-time evolution of the human race by applying these tools.

From using these tools, molecular evolutionary biologists have discovered that some of the best divers in the world, a people known as the Bajau, have evolved to have larger spleens. This gives them the ability to stay underwater longer, due to the fact that the larger spleens can store more oxygen for the divers. The Bajau live on houseboats in the waterways around and between the Philippines, Malaysia, and Indonesia. These divers have been recorded holding their breath for over five minutes while hunting for fish or shellfish. In comparison, average people might be able to stay underwater for one to two minutes, and world-class free divers can hold their breath in competitive settings for close to four and a half minutes. Previously, a crew filming for the BBC documentary series *Human Planet* recorded a Bajau hunter during dives and noted that his heart rate plummeted to a mere thirty beats per minute. (The diving reflex in most humans only drops the heart rate to perhaps fifty beats per minute in a healthy adult.) “They’ve been observed diving over 70 meters with only a weight belt and a set of goggles,” said one of the observers. “If they’re just collecting shellfish at 10 meters, they could spend all day doing these shallow dives. We were diving at one point and [a Bajau friend] looked down and saw a large clam. He dropped another 15 meters in an instant and grabbed it. It’s pretty remarkable.”⁴⁴

In the Himalayas, the Tibetans have evolved a greater capacity to adapt to a high altitude so that they do not experience hypobaric hypoxia, which is a significant stress for humans and other animals. High altitudes can be challenging to oxygen homeostasis and therefore tissue metabolism in mammals that live at lower altitudes. Genetic signals of physiological adaptation have been identified in human populations and nonhuman species with long-term residence at high altitudes. In Tibetans, some genetic signals are linked to altered metabolic function. A number of other genetic signals that may impact metabolism have been identified in Tibetans and other populations.⁴⁵

There are most likely many other examples of contemporary human evolution that await our discovery.

Mammalian Viruses

Viruses in mammals, including humans, have to use even more complex biochemical, physiological strategy to be able to penetrate the line of defenses that protect our cells from infection.

Immune Responses

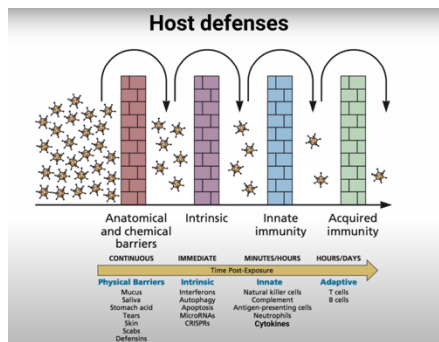


Fig. 31. A summary of host defenses.⁴⁶

Our bodies are fortresses against the constant spray of aerosols that bring viruses and bacterial cells in contact with our skin and orifices every moment of the day.

And that goes for other organisms too, who have immune systems or other clever protective machinery, such as the CRISPRs in bacteria (prokaryotes).

Fig. 31 summarizes the layers of barriers that we and other organisms have to protect ourselves from infectious agents, like the novel coronavirus.

Immune Response

Our immune response is composed of a stockpile of ammunition against invading microbes, viruses, and other foreign objects that are not in our body's best interest (mold spores and pollen, for example).⁴⁷

Function

The overall function of the immune system is to prevent or limit infection. An example of this principle is found in immunocompromised people, including those with genetic immune disorders, immune-debilitating infections like HIV, and even

pregnant women, who are susceptible to a range of microbes that typically do not cause infection in healthy individuals.

The immune system can distinguish between normal, healthy cells and unhealthy cells by recognizing a variety of "danger" cues called danger-associated molecular patterns (DAMPs). Cells may be unhealthy because of infection or because of cellular damage caused by noninfectious agents like sunburn or cancer. Infectious microbes such as viruses and bacteria release another set of signals recognized by the immune system called pathogen-associated molecular patterns (PAMPs).

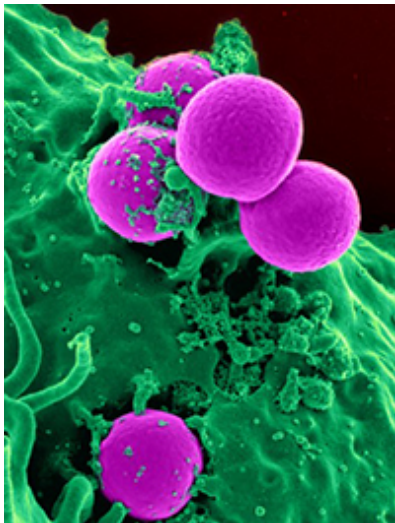


Fig. 32. Neutrophil (green) ingesting *Staphylococcus aureus* bacteria (purple). (Courtesy: National Institute of Allergy and Infectious Diseases)

When the immune system first recognizes these signals, it responds to address the problem. If an immune response cannot be activated when there is sufficient need, problems arise, like infection. On the other hand, when an immune response is activated without a real threat or is not turned off once the danger passes, different problems arise, such as allergic reactions and autoimmune disease.

The immune system is complex and pervasive. There are numerous cell types that either circulate throughout the body or reside in a particular tissue. Each cell type plays a unique role, with different ways of recognizing problems, communicating with other cells, and performing their functions. By understanding all the details behind this network, researchers may optimize immune responses to confront specific issues, ranging from infections to cancer.

Location

All immune cells come from precursors in bone marrow and develop into mature cells through a series of changes that can occur in different parts of the body.

Skin: Skin is usually the first line of defense against microbes. Skin cells produce and secrete important antimicrobial proteins, and immune cells can be found in specific layers of skin.

Bone marrow: Bone marrow contains stem cells that can develop into a variety of cell types. The common myeloid progenitor stem cell in bone marrow is the precursor to innate immune cells—neutrophils, eosinophils, basophils, mast cells, monocytes, dendritic cells, and macrophages—that are important first-line responders to infection.

The common lymphoid progenitor stem cell leads to adaptive immune cells—B cells and T cells—that are responsible for mounting responses to specific microbes based on previous encounters (immunological memory). Natural killer (NK) cells also are derived from the common lymphoid progenitor and share features of both innate and adaptive immune cells, as they provide immediate defenses like innate cells but also may be retained as memory cells like adaptive cells. B, T, and NK cells also are called lymphocytes.

Bloodstream: Immune cells constantly circulate throughout the bloodstream, patrolling for problems. When blood tests are used to monitor white blood cells, another term for immune cells, a snapshot of the immune system is taken. If a cell type is either scarce or overabundant in the bloodstream, this may reflect a problem.

Thymus: T cells mature in the thymus, a small organ located in the upper chest.

Lymphatic system: The lymphatic system is a network of vessels and tissues composed of lymph, an extracellular fluid, and lymphoid organs, such as lymph nodes. The lymphatic system is a conduit for travel and communication between tissues and the bloodstream. Immune cells are carried through the lymphatic system and converge in lymph nodes, which are found throughout the body.

Lymph nodes are a communication hub where immune cells sample information brought in from the body. For instance, if adaptive immune cells in the lymph node recognize pieces of a microbe brought in from a distant area, they will activate, replicate, and leave the lymph node to circulate and address the pathogen. Thus, doctors may check patients for swollen lymph nodes, which may indicate an active immune response.

Spleen: The spleen is an organ located behind the stomach. While it is not directly connected to the lymphatic system, it is important for processing information from the bloodstream. Immune cells are enriched in specific areas of the spleen, and upon recognizing blood-borne pathogens, they will activate and respond accordingly.

Mucosal tissue: Mucosal surfaces are prime entry points for pathogens, and specialized immune hubs are strategically located in mucosal tissues like the respiratory tract and gut. For instance, Peyer's patches are important areas in the small intestine where immune cells can access samples from the gastrointestinal tract.

Adaptive immune system

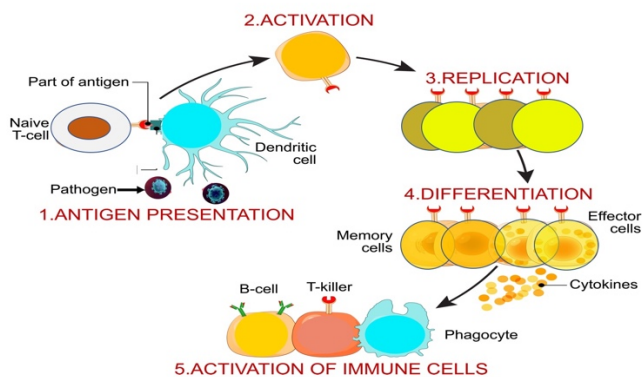


Fig. 33. The steps of the adaptive immune system.

Viruses in Our DNA

There are millions of viruses that do not make us sick. These viruses have been found in every living organism that we know. Determining the role of these benign viruses in our bodies leads to a path of continuous discovery.

Viruses in plants are responsible for an unusual striped pattern in tulips. Viruses in our bodies provide us with a gut microbiome when we otherwise would not have one due to medical treatment.⁴⁸

6 - What Sorts of Strategies Can Kill It?

This pandemic has resulted in many tragedies and has highlighted both the fragility and the strength of our biological defenses, and that of our environment as a whole.

In terms of our human population, not all of us will die. And those who survive will have a tolerance for the infection. Those of us treated with vaccines will also have some protection.

Vaccines

Our ancestors from the earliest recorded human history and from many countries and cultures have created ingenious solutions to treat those of us sickened by microbes such as the smallpox virus and the polio virus. We have come a long way from those early groundbreaking discoveries in human health, so that now, in 2020, more than twenty life-threatening diseases are preventable with a vaccine. Research is revved up into high gear to create new vaccines to protect us against the virus that causes the new disease COVID-19. I will describe what a vaccine is and how to understand the path of the vaccine from lab to you.

While I do know that there are folks who are afraid or suspicious of vaccines, my goal is to give you the facts. I will give you the tools to separate fact from conspiratorial fiction.

In that way, you yourselves can make your own decisions about which vaccines to take and when to do so. It is true that there are some places in the world where vaccines are mandatory. Sometimes this occurs when an outbreak of an infection is so pervasive that there is no other way to quell the spread and fatalities by a disease. If you are in a place in the world where you are free to make your own decision about being vaccinated, I hope that you can overcome your fears about it by learning as much as possible about vaccines. This booklet offers a starting point as well as good references to consult.

From Lab to You

There is a complex and well-designed system for vaccine development in health care systems around the world.

Viral vaccines are tested first in an artificial lab environment, or a "petri dish" scenario, to determine if the vaccine actually recognizes the protein or element of the virus that it is designed to disrupt in some way. This "petri dish" environment includes animal testing and is very involved. Animals that are used sometimes have to be genetically modified to mimic the human body, such as making sure the test animal has ACE2 receptors, like humans do, in the case of testing a novel

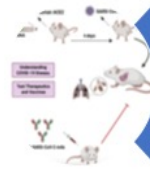
coronavirus vaccine. After these tests have been determined successful, the vaccine trials advance to the next phase.

This figure sums up the sequence of vaccine trials used by the CDC and followed by many other countries.



Fig. 34. Testing trial flow for vaccine development.

What is involved in each phase of vaccine trials is further described in the figure below.



1 - The vaccine is administered to **animals** to see if it produces an immune response.



2 - A **small number of people** are given the vaccine to test safety, dosage and stimulation of the immune system.



3- The vaccine is administered to **hundreds of people** split into groups, to see if the vaccine acts differently in them. More safety and immunity tests also done.

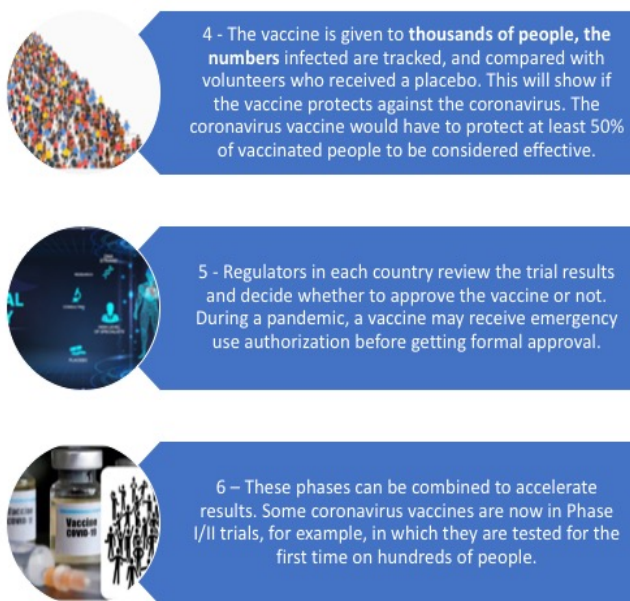


Fig. 35. The phases of vaccine trials are described to match trial flow steps one to six in Fig. 34. (Image credits: Microbe Whisperer, LLC)

COVID-19 Vaccines in Progress

The general idea behind a vaccine is to stimulate our immune response to something related to the virus of concern. This element or factor in the vaccine needs to have enough biochemical similarity to the actual infectious agent, the virus, so that the immune system is "tricked" into making antibodies against the virus of concern.

There are many molecular and biochemical strategies that vaccine researchers can use. Here are a few examples:

Genetic Vaccines: *Vaccines that use one or more of the coronavirus's own genes to provoke an immune response.*

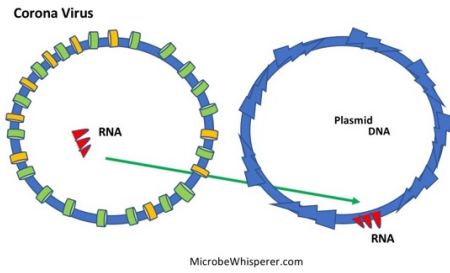


Fig. 36.

Viral Vector Vaccines: *Vaccines that use a virus to deliver coronavirus genes into cells and provoke an immune response.*

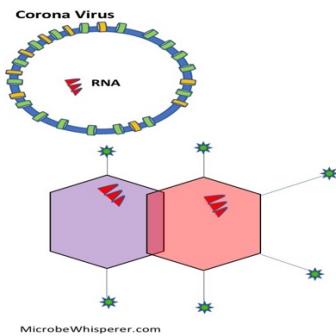
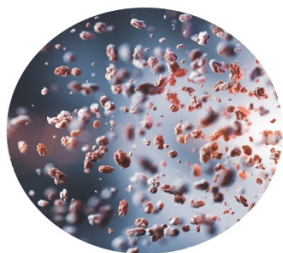


Fig. 37.

Protein-Based Vaccines: *Vaccines that use a coronavirus protein or a protein fragment to provoke an immune response.*



MicrobeWhisperer.com

Fig. 38.

Around the world, lab-coated figures are blurry with speed as their nimble, gloved fingers manipulate thousands upon thousands of vials, molecular tools, and machines. Their analytical minds and devoted hearts are focused in support of the medical teams that are toiling to a breaking point, developing a vaccine (or vaccines) that will prevent COVID-19 infection. Pharmaceutical companies have pushed timetables with unprecedented rapidity, resulting in new treatments that are at various stages of vaccine trials. More information on tracking the rate of progress for these trials is available on Contagion Live and can be accessed here: <https://www.contagionlive.com/news/the-covid19-live-vaccine-tracker>.⁴⁹

Vaccinations play an important role in the development of "herd immunity" for a population of people.

Herd Immunity

Herd immunity occurs in a population when a large percentage of the community (aka the herd) is immune to a disease. When enough of the "herd" is immune, then the disease stops spreading.

A certain percentage of the population must get a disease for it to spread through person-to-person contact. This is called a threshold. If the percentage of the population that is immune to the disease is greater than this threshold, the spread of the disease will decrease. This is known as the herd immunity threshold.

The percentage of a population that needs to be immune to reach herd immunity varies from disease to disease, depending on how contagious the disease is. As an example, measles is a highly contagious illness. So it is estimated that 94 percent of the population must be immune to interrupt the chain of transmission.

For us to achieve herd immunity against COVID-19, we can either follow the path of using vaccines or allow the infection to proceed.

Naturally, the more lifesaving path to herd immunity is to have vaccine against the COVID-19 virus. Vaccines create immunity without causing illness or resulting complications. Herd immunity makes it possible to protect the population from a

disease, including those who can't be vaccinated, such as newborns or those who have compromised immune systems. Using the concept of herd immunity, vaccines have successfully controlled deadly contagious diseases such as smallpox, polio, diphtheria, rubella, and many others.

Opposition to vaccines based on religious or personal reasons can pose a real challenge to herd immunity.

The other path to herd immunity is that of infection. When a sufficient number of people in the population have recovered from a disease and have developed antibodies against future infection, we can also attain herd immunity. An example of this scenario is the herd immunity achieved with the population that survived the 1918 flu (influenza) pandemic. These people were later immune to infection with the H1N1 flu, which is a subtype of the 1918 influenza virus.

Current research has not supplied us with clarity on whether the COVID-19 virus grants us immunity to subsequent infection. Research so far has shown us that after infection with some coronaviruses, reinfection with the same virus is possible after a period of months or years. More research is needed to determine the protective effect of antibodies to the virus in those who have been infected.

Even if infection with the COVID-19 virus creates long-lasting immunity, a large number of people would have to become infected to reach the herd immunity threshold. Expert estimates suggest that in the US, 70 percent of the population (or more than 200 million people) would have to recover from COVID-19 to stop our current epidemic.⁵⁰ But this amount of infection could also lead to serious complications and millions of deaths, especially in those most vulnerable to the disease.

These facts further support an approach to herd immunity using vaccines instead of allowing more people to become infected.

Antibody Treatments

Antibodies are part of the immune response system in humans and many other organisms. They are illustrated in diagrams as Y-shaped molecules due to their specific biochemical structure that appears to be shaped that way. As discussed above, antibodies are produced by B cells in our bodies. Here is a diagram outlining the activation of B cells when a virus invades our body.

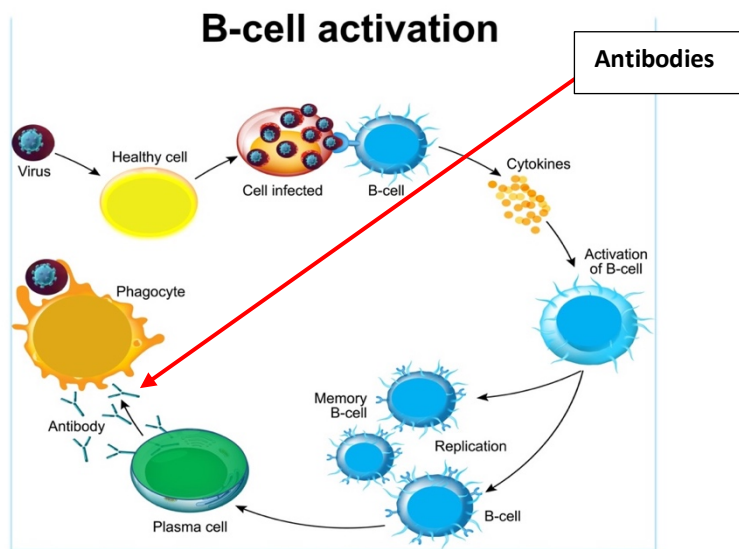


Fig. 39. How antibodies are produced from B cells. After production, antibodies join phagocytes to attack the virus.⁵¹

Blood Plasma Antibodies

At the date of this writing, SARS-CoV-2 and the disease it causes remains widespread, crippling to our bodies and to our economy. And at the time of this writing, we are on the verge of deploying the first vaccines in the US and are developing proven therapy for those who become infected.

But our scientists and medical practitioners were not without hope prior to these developments. They provided us with some short-term relief and immunity. This included the delivery of immune plasma (also called "convalescent" plasma).

What Is Blood Plasma?

This is the liquid from your blood without the red blood cells, white blood cells, and platelets. Without those components, plasma looks like a light-yellow liquid. Containing salts, water, and enzymes, plasma's role is to ferry nutrients, hormones, and proteins throughout our bodies. The plasma's other role is to carry away cellular waste and dispose of it.

Immune plasma is collected from people who have been sick with, for example, the COVID-19 virus and have gotten better, due to the fact that they developed antibodies to the virus.

When patients are sick with COVID-19, this immune plasma can be given to them via plasma transfusion. Giving convalescent plasma to infected patients has a good track record, as it was used successfully during other coronavirus outbreaks, such as the outbreaks of SARS-CoV-1 and Middle East Respiratory Syndrome (MERS).

The data that has been collected so far shows clinical improvements with convalescent plasma given to the COVID-19 patients. These improvements include, among other things, a reduction in the virus concentration and improved survival for those infected.

What Are Monoclonal Antibodies?

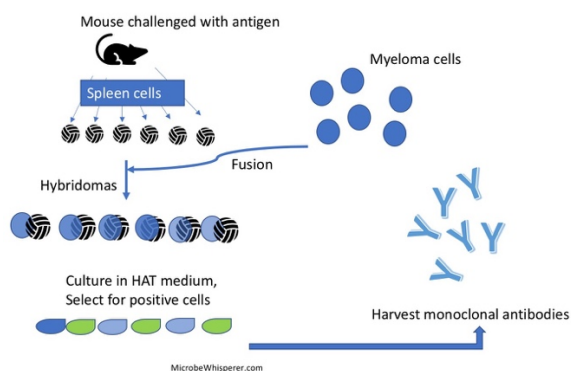


Fig. 40. This diagram shows a generic

method for the production of monoclonal antibodies.

Monoclonal Antibodies

These are **antibodies** that are bioengineered to target specific areas on a virus. The process results in clones, or antibodies that are identical and bind to the same area on a virus or other infectious agent.

Monoclonal antibodies have been used to reduce the mortality in patients infected with the Ebola virus. Because this virus has been treated successfully with monoclonal antibodies, it has encouraged medical scientists to try this type of treatment of COVID-19.

Currently, several SARS-CoV-2 monoclonal antibodies are undergoing therapeutic trials.⁵²

Natural Remedies

Natural medicine isn't always relegated to folklore. In fact, many natural medicinal cures have a scientific basis. For some examples of this, consider my blog post on the novel antibiotics discovered in Ireland in soil that had long been used in folkloric medicine by the village medics to treat bacterial infections. Learn more about Irish soil that holds a promise for new antibiotics [here](#).⁵³

When the novel coronavirus first overtook China, several papers on natural cures for the infection were published.

In the past, when doctors did not yet know about germ theory, they would advise their patients to carry or burn herbs or flowers and use particular potions to cure such illnesses as smallpox and the black plague (see Table 1). The spiritual leaders of these dark times would label illnesses that had no identifiable cause as punishments from divine forces or curses from evil ones.

Modern Natural Remedies

We know much more now about "germs," or microbes, than those from the last century. Most importantly, as modern denizens of the twenty-first century, we know that our [gut microflora](#)⁵⁴ and the unique communities of microbes on our bodies play crucial roles in keeping our immunity strong and us healthy in body and mind.

Microbe Whispering integrates this vast community, our bodies' microbiomes, into a practice that is spiritually and physically positive. We can fight off infection by doing a key thing that helps boost our immune system. We can [refuse to give in to fear](#).⁵⁵

By recruiting our personal cadre of microbes, by listening to what they need, to do their best job for us, we can keep our bodies strong to fight off infections, including the COVID-19 virus.

We are resilient residents within Mother Earth's ecosystem.

Since we are part of the organic ecosystem on earth, we have natural abilities to keep ourselves safe from microbial (including viral) incursions. Otherwise, we would not have survived on this planet for this long. These natural abilities are part of our [human immune system](#).⁵⁶

By encouraging the [healthy microbes](#)⁵⁷ in our bodies, called our microbiomes, we can do a lot to keep ourselves shielded from the novel coronavirus and other bacterial and viral infections that arise in our ever-changing environment. Not only do we have bacterial microbiomes, we also have viral ones. Here's more on that: [the human virome](#).⁵⁸

7 - Science and Sci-Fi

Science

Mouth Spray Carries Virus

There are countless examples in microbiology and medical texts that illustrate the trajectory of droplets when we speak, cough, or sneeze. For a specific scientific reference, please read this paper, titled "[Exhaled Droplets due to Talking and Coughing](#),"⁵⁹ which was published in December 2009, long before our current pandemic. It has been a well-known, documented, and medically sound fact that many respiratory diseases are spread by exhaled droplets from carriers of a disease.

We wear masks to stop the spread of these droplets that have the potential to carry viruses. Once we breathe in enough of a viral load (or titer) from these airborne droplets, the potential for us to become infected increases. We know this to be true due to not only scientific studies, but also how quickly we've seen it spread in enclosed and crowded spaces.

There are other solutions besides the sensible precautions we are taking by wearing masks, washing our hands (with solvents that disrupt the viral protein coat), and ensuring physical distance from others. These solutions entail methods to prevent us from breathing in viral-loaded exhaled droplets. These can be developed by the human ingenuity that abounds on our planet by inventive and creative minds. We already have existing technology for a starting point. There are water droplet capture systems that can conceivably be modified to better capture viruses and deactivate them from our exhaled breaths.

Some starting points for these inventions are mentioned in the following sections.

What Sorts of Devices Can Capture and Contain It?

Air Filters

Air filters are used in heaters, AC, air purifiers, and cars to collect particulates that can affect indoor air quality and that can affect a car's internal combustion system.

Indoor air quality is usually compromised of particles such as dust, pet dander, and viruses. While many of these particulates (and fumes) can cause allergic reactions and become potentially life-threatening, it is the viruses that make it particularly motivating for us to devise new methods of capture.

How Does an Air Filter Work?

The air filter in your heater or AC traps small particles from the air before allowing air to pass through to the duct system in your home. The air is filtered when it

passes through the AC or heater because of the filtration systems that are in place in these devices. Mechanical air filters are the ones used in heating, ventilation, and air-conditioning (HVAC) systems, and they work by trapping particles from the air in the filter. These filters are disposable and need to be replaced and cleaned at regular intervals. High-efficiency particulate air (HEPA) filters are a type of high-efficiency mechanical filter.⁶⁰

What Is MERV?

An air filter is usually made of a spun fiberglass material or from pleated paper or cloth enclosed in a cardboard frame. The capacity for an air filter to remove certain particulates, from pollen to dust to gas fumes, is based on how porous it is. And this efficiency is measured by a value that uses the acronym MERV: the [Minimum Efficiency Reporting Value](#).⁶¹

A MERV provides measurable information on the effectiveness of an air filter.

The rating scale ranges from 1 to 20. Higher ratings indicate greater filtration capabilities.

- MERV 1–4: Removes pollen, dust mites, cockroach body parts, sanding dust, and textile and carpet fibers
- MERV 5–8: Removes mold spores, cat and dog dander, hair spray, and dusting sprays
- MERV 9–12: Removes humidifier dust, lead dust, flour, and auto emissions
- MERV 13–16: Removes bacteria, cooking oil, sneeze droplets, most smoke, and dust from insecticide spray
- MERV 16–20: Removes viruses and all smoke

The following table summarizes the average arrestance and applications of filters along the MERV scale and the typical particle size for which they are used.

MERV	Avg. Arrestance	Particle Size Range
1–4	60–80%	>10.0 microns
5–8	80–95%	3.0–10.0 microns
9–12	>90–98%	1.0–3.0 microns
13–16	>95–99%	0.30–1.0 microns

The MERV of a filter is determined with laboratory tests according to American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Standard 52.2.

HEPA Filters: High-Efficiency Particulate Air

[High-Efficiency Particulate Air](#) (HEPA) filters outclass even the MERV 16 filter rating.⁶² While a MERV 16 filter captures more than 95 percent of particles in the entire size range tested (0.3 to 10.0 microns), a HEPA filter captures 99.97 percent of particles with a size of 0.3 microns. The filtering efficiency is even higher for particles larger or smaller than 0.3 microns. HEPA filters can capture many airborne germs and also nonliving pollutants, such as fine particulate matter.

Many ventilation systems are not designed for HEPA, but these filters are also available as portable air cleaners or vacuum cleaners.

HEPA filters are recommended for critical health care applications like anterooms, isolation wards, and [COVID-19 patient rooms](#).⁶³

When educational institutions reopen after the coronavirus outbreak, ASHRAE also recommends a portable HEPA and UV air cleaner for each classroom, with at least two air rotations per hour.

Inventive Modifications

UV Light

Ultraviolet germicidal irradiation (UVGI) is used to disinfect air that is circulated by air filtration systems. It is possible that some inactivation of virus particulates, which has already been shown to occur with this UVGI system, can be amplified. Portable systems that filter and irradiate air are commercially available now for hospital use: for example, this [one](#).⁶⁴ More information on how UVGI has been studied for the inactivation of the COVID-19 virus can be found on the CDC website [here](#).⁶⁵

Capture and Contain Water Droplets

Since virus particulates, like SARS-CoV-2, are carried aloft within aerosols—suspensions of liquid droplets in air—repurposing devices that capture water droplets from air to inactivate the virus seems feasible. Systems that involve mesh to capture water from fog, or systems that imitate how leaves funnel captured water droplets, are described below.

Fog Harvesting

There are air-from-water devices that harvest water from the atmosphere. The mining of moisture from air involves a system that looks like fine-meshed volleyball nets. There are issues with making the mesh fine enough to capture water by surface tension but not so fine that the mesh gets clogged and the water is no longer captured.

Scientists address this problem by adding different types of coatings to the mesh materials. They are also trying out different structures, finding inspiration from

plants, which have developed clever ways to stay hydrated by way of their leaf or needle structure.

In one of these cases, researchers are looking at how giant sequoia trees collect water from fog on their needles. These needles are parallel to one another, so water collects on the needles, rolls downward, and then drips onto the ground to nourish the tree's roots. Scientists are working on creating the same effect by creating a fog harp—an apparatus made from vertical parallel wires.

Fig. 41. Click on this image to learn more about these types of fog-harvesting devices.⁶⁶



Sci-Fi

Superheroes

What our pandemic-riddled world needs is Superman! He might fly into outer space to procure a rare element on another planet that is the SARS-CoV-2 kryptonite!



Fig. 42. It's a bird, it's a plane, it's Superman!

Or Superman could fly very, very fast around Planet Earth, turning us back in time to prepandemic, then telling us about it so we have the cure ready before it strikes.

For that matter, a starship, like the Enterprise from *Star Trek*, could find a temporal anomaly that takes us back in time before the COVID-19 crisis, again, so we could be ready for it. Or Dr. Leonard McCoy, the good Starfleet doctor, could work around the clock and, with Spock's brain to help him, find a cure for the virus against all odds, like he did in "Miri." Hopefully our real-life medical heroes won't have to inject themselves with a cure to test it in dramatic, last-minute desperation the way Dr. McCoy did in this episode!



Fig. 43. Dr. McCoy and Mr. Spock in "Miri," *Star Trek: The Original Series*. (Courtesy: [yourprops.com/user/rkpetersen](https://www.yourprops.com/user/rkpetersen))

8 - Magic

Magic is essentially defined as a process that bends around or defies the laws of matter and time as we perceive it. It can be a noun, a verb, and an adverb.

Noun example: "Harry Potter learned about magic while studying at Hogwarts."

Verb example: "She was magicked into that aquarium to swim with the dolphins."

Adverb example: "He waved his wand and magically produced a garden of roses for his mother."

Magic can involve detailed rituals, spells, and incantations. Magic can be accompanied by elaborate accessories, such as wands, crystals, and gemstones.

Or magic can be a simple act of love and kindness. Magic can be created by people or by nature. Magic can also be a type of experience we feel when something extraordinary occurs that produces feelings of transcendence, such as witnessing the birth of a baby, watching a shooting star, seeing a marvelous sunset, or falling in love. Magic takes on many mystical, fantastic, and mysterious forms.

When times are tough, when we are undergoing insurmountable odds or pandemics, we might yearn for a solution that is magical. When we are tormented by vile behavior or horrific events, we might feel as if we could really use an act of magic to remove the obstacle, cure the disease, or sweep us aloft, far away from the misery.

While we cannot wave a magic wand and recite an incantation in Latin to remove the COVID-19 virus from our lungs and from our world, we do have the power to create extraordinary acts that can effect a cure.

Literature and cinema are filled with stories of science appearing as magic to a person who does not have the same kind of technology in their life experience.

The Neanderthal confronted by an airplane flying in the sky or a remote control producing an image on a TV screen could consider these objects as being supernatural or even divine.

Some episodes of the popular series *Star Trek* also deal with these matters: e.g., "Who Watches the Watchers" with the Mintakans and "Justice" with the Edo. In these cases, neither the Mintakans nor the Edo have reached the technological advancements of the Enterprise crew and thus view the starship and all the devices from the Starfleet crew as "godlike."

In our human history, while the black plague or cholera decimated populations and germ theory had not yet taken hold, these microbial-induced afflictions were blamed on supernatural forces of evil. And divine intervention or magic was what

the populace turned to—if not for cures, at least for solace and easing of the heart and mind.

However, some wise people practiced herbal medicine and folk cures. These wise humans understood the connection of disease with an unclean environment and noticed that infections occurred with filthy bandages. They applied the simple cures of using fire, soap, water, and disinfectants to keep diseases away. Some went as far as ensuring that water was boiled before drinking, that food was thoroughly cooked, and that spoiled food was discarded.

In my card deck, *Microbe Whisperer Cards for Environmental Healing: Divination and Education*, I have a suit called the "Loops" suit. This particular suit was inspired by the inoculating loops that microbiologists use to transfer things in a sterile way. For example, to transfer a colony of bacteria from one petri dish to another, sterile or "aseptic" technique is used. This involves sterilizing the metal wire inoculating loop with fire by holding it over a Bunsen burner flame.



Fig. 44. The number "7 Loops" card from *Microbe Whisperer Cards for Environmental Healing: Divination and Education*.

As explained in the Guidebook for this card deck, the "Loop" suit corresponds with the "Wands" suit in the traditional tarot card deck.

What does this have to do with magic?



wand.

Fig. 45. A boy with a magic

A wand is one of the accessories that is typically associated with acts of magic.

And in the Loops suit for the Microbe Whisperer Cards, a flame-sterilized tool from the science of microbiology is illustrated. In this way, magic and medicinal science intersect, as flame and sterilization are an efficient means to kill infectious disease agents, such as bacteria and viruses. The virus does disappear like "magic" when it is burned, of course.



Fig. 46. Science is magic. (Copyright, Microbe Whisperer, LLC., JeM YinJoy, PhD.)

By harnessing our own unique mind-body-spiritual powers, we really can create a magical solution to channel the *superhuman* in all of us. With a flick of a molecular switch, and using the modern tools of biological medicine, we can snip away the genes in the virus that makes us sick and create an elixir called a vaccine to keep COVID-19 at bay. From the viewpoint of our ancestors, that really is a magic trick! And we are fortunate to have these sparks of incandescent power at our fingertips.

9 - Spiritual Lessons from These Teachers

A review of the current scientific literature on the coronavirus has given me an informed intuition on how this virus acts and the spiritual lessons it has to teach us.

Why Did This Virus Choose Us?

Why did the virus choose us? What is the spiritual message?

Please remember that in the world of the physical, the virus is simply a chemical agent that shifts into gear once it enters the host. It's similar to a bit of salt added to water. The salt has no conscious desire to do anything at all. Its chemical properties lead it to dissolve in the water every time, ionizing the elements of Na and Cl that had made up its crystalline solid form. However, in the case of the virus, its chemical properties are not only dissolution. Its chemical properties include strategies that lock on to a receptor on our cells, enzymes that allow the virus to shed its outer skin and penetrate our targeted cells and allow the virus to make multiple copies of itself.

In short, the virus is simply following its nature. Its nature is to replicate itself when it finds itself in a conducive environment to do so.

In many philosophies, our bodies are considered representatives of the cosmos. So the virus infection is mirroring our own natural infection of our planet.

Do we not modify and penetrate the barriers of a planet's harsh environment to turn its machinery into making more of ourselves? Humankind is the only creature that wreaks a global level of destruction of the planetary environment to suit its purpose.

Humankind's purpose is to manipulate the land, the water, and the air to benefit our own comfortable existence. This artificially created comfortable existence feeds us and shelters us, ultimately to enable us to reproduce. Our population has grown exponentially, and with it, our progeny continue to modify the land and disrupt more of nature in order to successfully live upon it.

The virus does not know that by following its biochemical nature, it is wreaking destruction on our bodies. Our bodies are basically the "planet" for this virus. Perhaps by holding up the mirror to us, one of the clearest messages from the virus is to see ourselves in it and see the reflection of its mode of destruction that benefits its sole existence.

Given that our planet is in the throes of an environmental crisis, it is important for us to realize that our activities on our planet may be no different than that of this

virus. The difference between us and the virus, however, is that we do have a consciousness. And it means that we can choose to decelerate our path toward the complete destruction of our planet.

Lesson 1 - The virus is big mirror for us.



Fig. 47. A handheld mirror with the reflection showing SEM images of the novel coronavirus (virus color is added for artistic purposes).

The virus is adept at taking advantage of opportunities to carve out new niches for itself. And its sole purpose is to hijack the host and create more of itself.

This very much reflects, or mirrors, what we humans do and have been doing since we first started establishing our habitations, hunting grounds, farming lands, mining sites, and oil wells on this planet. Rather than live with nature, we modify nature to suit us. We carve out new niches to propagate more of ourselves by razing down forests, polluting water, and overheating the land with greenhouse gases.

The virus is a big mirror. It is showing us a reflection of what humanity has been like living on Earth. Except, from the virus's perspective, we are its "Earth." By simply living out its nature, this SARS-CoV-2 virus is mirroring how we ourselves have affected the health and well-being of our own Mother Earth.

Lesson 2 - The virus attacks our airways and lungs.

The virus finds ACE2 receptors on the cell lining of our mouths, noses, esophageal tracts, and lungs. There are also ACE2 receptors in our brain and heart cells.

One of the main effects of the virus infection is that our lungs are flooded from the cellular immune response. We cannot take in air when our alveoli are congested with all that fluid from the immune response, so we are unable to breathe.

In an analogous way, we are acting like this virus too, as our impact on the planet has compromised Mother Earth's "lungs."

Mother Earth's Lungs

There are living creatures that evolved before we did, a long time ago. And they only needed the light from the sun and carbon dioxide from the air to live and to grow. These were the photosynthetic forms of life. Photosynthetic creatures use the sun and carbon dioxide for their food, while they expire oxygen. And it was this type of metabolism by these photosynthetics that first filled our earth's atmosphere with oxygen. This led to the evolution of oxygen breathers, like ourselves. We depend on the oxygen expired by these photosynthesizers for our own biological machinery to work and keep us alive. They were microscopic, these first photosynthetics. They left their fossilized evidence embedded in our earth's rock history. These were cyanobacteria, water-dwelling one-celled microbes. But these gave rise to multicellular algae, and then to vascularized plants, and then to towering trees encased in enduring skins of wood.

There is a NASA video that shows a dramatic view of how this vast plant-wide compilation of photosynthetic living beings acts to clean up our atmosphere, cycling carbon dioxide out of our air. You can view that video [here](#).⁶⁷ This NASA video tracks the flow of carbon dioxide across the planet over twelve months, starting in January. The orange and red swirls show high amounts of CO₂ hanging out in our atmosphere—until June. During the summer months, leaves are bountiful on trees and the CO₂ is removed from the sky.

We exchange a cycle of essential gases with this photosynthetic biome, where plants cycle out oxygen for us and take in CO₂ for themselves in a mutualistic flow. In that sense, the photosynthetic cohabitants on our planet can be considered the lungs of Mother Earth.

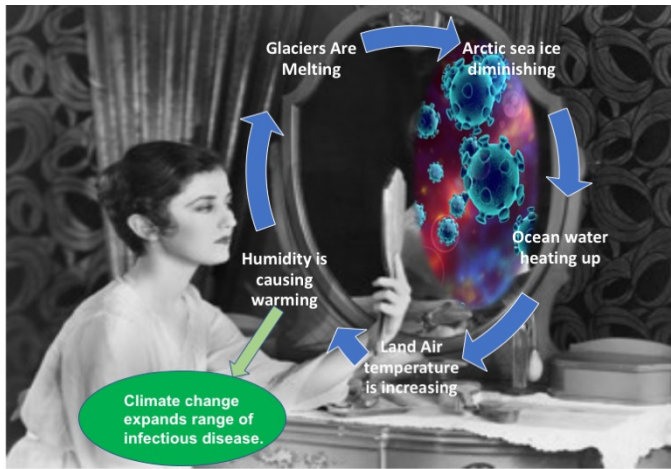


Fig. 48. We see the coronavirus as a reflection of how we hijacked the planet. (Copyright credit: JeM YinJoy, Microbe Whisperer, LLC, 2020)

As the coronavirus affects our airways, it shows us in this lesson a reflection of how we have affected the airways of our planet with our environmentally compromising activities.

Coronavirus Oracle Card

There are eleven cards in each suit of my forty-four-card Microbe Whisperer Oracle Deck. However, given the current pandemic crisis, I have created a placeholder for additions to this oracle card deck in the future. The COVID-19 virus has become one of the first to expand the deck.



Fig 49. The SARS-CoV-2 Oracle Card (placeholder).

As with the other microbe guides in the Microbe Whisperer Guidebook, I include a haiku and a bulleted list of the spiritual lessons that this viral spiral guide has to teach us.

It is up to you, the reader, to apply these attributes in a way that seems most helpful to you in this stage of your life's journey.

COVID Haiku

**With drowned lungs attacked,
we grew gills to swim in streams,
like salmon in Fall.**

Lessons from the SARS-CoV-2 Virus

- **Opportunistic**
- **Blind obedience to its nature**
- **Single-minded destruction**
- **Quick to mutate**
- **Adaptable to many habitats**
- **No ability to self-edit**
- **Clever strategies for invasion**
- **Power to topple civilizations**
- **Landscape game changer**

What Microbe Spirit Guides Are Saying to Us

To whisper to the Microbe Spirit Guides, you can implement techniques that are already familiar to you. As mentioned before, meeting with and speaking to your animal spirit guides involves a shamanic journey. Reaching this altered state of consciousness, though, can be achieved by many means.

My practice with communicating with Microbe Spirit Guides includes journeying, rituals, and tools, such as a card deck that shows images or symbols of spiritual guides. But I can also reach a state of communion with Microbe Spirit Guides by simply taking a quiet walk in the woods or along a peaceful shore. Meditation is also helpful to reach this state of altered consciousness, especially if you need to whisper to microbes on your own body. Any means that you have discovered to be effective for you personally to align you with a sense of spiritual-realm consciousness will work for Microbe Whispering too.

In my case, for conveying information needed in this booklet, I have asked the Microbe Whisperer Spirit Guides in my card deck for some insight on the viral pandemic. The Microbe Spirit Guides that came forward to advise on this COVID-19 crisis are listed below as i), ii), and iii). I will explain in more detail what the wisdom of each guide shares as it applies to the current pandemic. After all, microbes are adept at keeping attacks from viruses (phages) in check. They can certainly be an insightful resource on how we can do the same, as long as you understand their whispers. Fortunately, I am providing an interpretation of their counsel for your benefit.

i - Tube Worm Symbiont

ii - Winogradsky Column

iii - Nitrospira Briensis: Ammonia to Nitrite Nitrobacter Winogradskyi: Nitrite to Nitrate (Nitrogen bacteria in soil)

i - Tube Worm Symbiont

Tube Worm Symbionts are a very specialized type of bacteria. They are called thioautotrophs because these bacteria eat by oxidizing sulfur (“thio” means sulfur in Latin) and because they make food for their hosts in the form of organic carbon. Their hosts, the tube worms, provide them with a protected home. They live symbiotically inside the tissues of a tube worm called *Riftia pachyptila*. The Riftia tube worm has no mouth or digestive tract of its own, so it is completely dependent on these symbiotic bacteria for its nutrition.



Fig. 50. Tube Worm Symbionts: Card #2 from the Petri Dish Suit in the Microbe Whisperer Card Deck.

These tube worm microbial symbionts are poised to make a profound contribution toward solving our global climate crisis.

In a distant, perhaps dystopian, future, we may need to resort to living within environmentally controlled domes if our planet careens into disaster. These symbiont microbes have the potential to contribute to our future habitats that do not rely on sunlight and plants.

How can this be? Well, an ecosystem depends on organisms that can fix carbon dioxide to organic carbon. On the surface of our current earth, these organisms are plants or other photosynthetic organisms, such as algae and photosynthetic microbes (blue-green algae). These are the organisms that presently act as Mother Earth's "lungs" as discussed before.

But under the sea, the task of being the primary producer, which is usually the job of the plants and other photosynthetic organisms on the sunlight-capturing part of Earth's surface, is taken over by microbes such as the tube worm symbionts. The tube worm symbionts oxidize sulfur for energy needed to make carbon compounds from carbon dioxide. These carbon compounds then feed its host. This is analogous to what plants do as they create carbon compounds from carbon dioxide, thus filling the role of primary producers by using sunlight. As humankind develops alternate living environments, it becomes important for us to learn how to replicate primary producer roles by using photosynthetic alternatives, such as the sulfur-oxidizing bacteria.

Our role as humans will continue to evolve in step with the environmental challenges that we face as climate changes continue to have an impact on where we can live on the planet. Alternative primary producers will play a key part in how we prepare to live in environments that might be devoid of the solar energy, where photosynthesizers like plants will no longer be able to act as our primary producers. The knowledge gained by microbiologists now will contribute to artificially created environments, should we need them to survive in the future.

The Tube Worm Symbiont Spirit Guide

Riftia pachyptila have as part of their bodies a unique morphological adaptation designed specifically to house bacterial endosymbionts. This adaptation is the trophosome where endosymbionts reside, having evolved alongside their hosts for millennia. So much evolution together was bound to create an inseparable bond. The host, in this case the tube worm *Riftia*, has bent over backwards and sideways to modify its own physical appearance to accommodate its endosymbionts.

Sounds a bit like what our planet has had to do to accommodate us, a form of symbionts on Earth. And the relationship between endosymbionts and *Riftia* tube worms is reflected in humans and Mother Earth. We cannot really escape this planet, so we had better start treating her right. Otherwise we run the risk of poisoning the very structure that keeps us rooted to the ground and protected from the unfiltered blaze of the sun.

We need to start accommodating the earth's needs too with even more determination if we plan to continue our symbiosis with this home for centuries to come. This means overhauling infrastructures that have been in place for a long time while compromising ecosystems. This means living in ways that might seem uncomfortable at first.

Ultimately, the rewards will be a continuation of snuggling humans in sweet folds of clean, fertile soil, wrapped lovingly in sheaths of purified air and suckling contentedly on toxin-free waters.

ii - Winogradsky Column

A Winogradsky column is a microbial “garden” or “city” that grants one a window through which to witness the development of a microcosm of Earth’s microbial community. It is contained in a clear glass jar (or other similar clear material like a plexiglass jar or a graduated cylinder). The column is named after a famous Russian microbiologist, Sergius Winogradsky (1856–1953), who studied the relationships between different types of microorganisms in mixed communities. One way to prepare a Winogradsky column is to collect some sediment from the bottom of a lake or river and make layered additions of various substrates to it. This sediment contains within it a community of millions of diverse microbes that depend on one

another for survival. The Winogradsky column creates an artificial replicate of what goes on in the sediment so that these diverse communities are stratified. These layers of different bacterial communities are separated by their access to oxygen and by access to nutrients, which are depleted or abundant depending on where they are located in the column's strata. They also are separated by the acidity or alkalinity that forms during the metabolic activities of the various communities that develop in the column. There are many variations on the basic concept of making a Winogradsky column. You may visit my [four-part YouTube video](#) series on how to create this column on your own.

The microbes that grow in a Winogradsky column are relatively predictable, as they fall within certain metabolic groups, with the most obvious being the anaerobes at the very bottom of the column, where oxygen deprivation is highest, and the photosynthetic aerobes on top, where light and oxygen are abundant. The Winogradsky column is a microcosm of how bacteria interact on the surface of our planet. Like on land, there are water bodies that are drenched by sun and infused with oxygen that provides the perfect environment for photosynthetic microbes. On the opposite end, deep down in the sediment, are the anaerobic microbes that prefer the dark and no oxygen. And in between, there are a variety of opportunists that feed off the side products made from the anaerobes below, and in turn excrete products that feed the microbes in the next layer above, all the while thriving in the gradient of their choice with the perfect blend of food, oxygen, light, and pH for their specific requirements.

The Spiritual Guidance of the Winogradsky Column

The success of a perfectly honed barter economy is taught within the wonderful microbial community that pops up in a Winogradsky column. Many human microcosms illustrate the same concept: What might be your neighbors' excess could nourish you and your family; what is not used can be passed further along the chain of people who can convert your disposed items into something useful for them. The microcosms that exist this way can be long-lasting, like the barter system economy that develops in a country going through severe financial struggles, or short-term, like the money-free tradition at the Burning Man music festival. The idea is the same: Without the exchange of money, a human community is supported, as goods and services of equal value are exchanged and currency is off the table.

As of this writing, our global society still relies on money for the exchange of goods and services and for our global economic stability. And the majority of us are not convinced that a barter economy is feasible. But stick us all in a container like a Winogradsky column (built to human dimensions) and see how quickly we either become cooperative and rely on each other for goods or expire if we refuse to share in the venture. Do you think we may be getting to that point now?

In a figurative sense, we may be stuck in a jar as the COVID-19 pandemic keeps us in self-isolation. We have been relying on our fellow humans to do the right thing when it comes to hygienic handling of our delivery items and wearing masks when we are exposed to each other in public places. The pandemic has obligated us to become more dependent on each other to behave kindly, generously, and compassionately. The Winogradsky column Microbe Guides remind us and those who are inspired by acts of kindness that we are here to share our abundance and receive gifts from others who are of like mind and compassionate heart.

iii - *Nitrospira Briensis*: Ammonia to Nitrite *Nitrobacter Winogradskyi*: Nitrite to Nitrate

Nitrogen is essential to life because it is a key component of proteins and nucleic acids. Nitrogen occurs in many forms and is continuously cycled among these forms by a variety of bacteria. Although nitrogen is abundant in the atmosphere as diatomic nitrogen gas (N_2), it is extremely stable, and conversion to other forms requires a great deal of energy. Historically, the biologically available forms NO_3^- and NH_3 have often been limited; however, current anthropogenic processes, such as fertilizer production, have greatly increased the availability of nitrogen to living organisms.

The cycling of nitrogen among its many forms is a complex process that involves numerous types of bacteria and environmental conditions.

In general, the nitrogen cycle has five steps:

- Nitrogen fixation (N_2 to NH_3 / NH_4^+ or NO_3^-)
- Nitrification (NH_3 to NO_3^-)
- Assimilation (incorporation of NH_3 and NO_3^- into biological tissues)
- Ammonification (organic nitrogen compounds to NH_3)
- Denitrification (NO_3^- to N_2)

Nitrospira is one of the select groups of bacteria that contribute to the nitrogen cycle. This is how nitrogen is kept cycling from the atmosphere as nitrogen gas to ammonia and back to nitrogen gas again. All life on Earth needs nitrogen for making amino acids, which build our proteins. But nitrogen gas can't be used directly by plants and animals. Instead, food-making organisms such as plants get it from soil by absorbing nitrates (various nitrogen compounds containing oxygen) and ammonium compounds (various nitrogen compounds containing hydrogen). The nitrogen cycle is essential to plants in unfertilized soils because in such soils the nitrogen compounds are not available to the plants in any other way. Animals and other living things that do not make their food depend on the nitrogen cycle indirectly. Most animals, for example, eat plants or eat plant-eating animals.

Nitrospira briensis is a tightly coiled being that still remains a mystery to microbiologists. Once thought to be part two of the nitrification tag team for the nitrogen cycle, it now turns out to have all the tools it needs without depending on others. *N. briensis* inserts herself into aquariums, where she bubbles away nasty ammonia that can kill fish, and wastewater, where she can scoop up undesirable nitrogen (nitrite and nitrate). She does this all by joining in the nitrogen-atom-ball-tossing game, which a select few other microbes do to keep nitrogen from leaving our planet forever as nitrogen gas. She is also a nonharmful resident on the bacterial biofilms of the Acropolis ruins in Greece.

N. winogradskyi plays an important role in the nitrogen cycle by oxidizing nitrite into nitrate in soil. Microbiologists have studied how nitrifying bacteria such as those in the genus *Nitrobacter* can be used for ammonium removal of wastewater effluents. In this way, *N. winogradskyi* and its relatives in the genus *Nitrobacter* can be used in treating wastewater for bioremediation of effluents. Extracellular polymeric substances (EPS) secreted by *Nitrobacter* species are involved in forming biofilms with the capacity to convert nitrite to nitrate. This feature of *Nitrobacter* species is also important in the development of removing ammonia from soil and water.

The ability of *N. winogradskyi* to metabolize both with and without oxygen suggests its comfort with the duality of existence. Its shapes are variable, with a pear shape when it's about to bud a new sister. The variable shapes are due to irregular growth and buildup of internal fat storage. This means that it is not concerned as much with outward appearance as it is ready for starvation conditions. With that sort of an Eagle Scout mentality, *N. winogradskyi* is always prepared.

Nitrogen Bacteria and the Coronavirus Purge Meditation

The nitrogen bacteria, through their natural nitrogen cycle, taught me a meditation for how to purge the coronavirus from our collective lungs. I want to share this wisdom with you and invite you to learn this Coronavirus Purge.

The nitrogen cycle involves pulling nitrogen out of the atmosphere and changing it to forms that can be used by plants. When plants die or animals leave waste products, the nitrogen is in an organic form (ammonia, urea, and such). This organic form is changed back into nitrogen gas by going through a cycle of oxidation and reduction by microbes. This cycle keeps the nitrogen element from completely dissipating into the atmosphere.

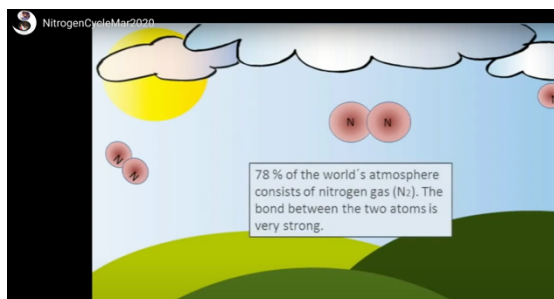


Fig. 51. The nitrogen cycle. Click on image for video.

And this conversion from nitrogen gas to mineral forms of consumable nitrogen is performed by specialized groups of microbes. *Nitrobacter* and *Nitrospira* are integral parts of the tag team that keeps the nitrogen cycle rolling. *Nitrobacter* and *Nitrospira* work together to "pass the ball" of nitrogen from ammonia to nitrite to nitrate before becoming nitrogen gas again (via microbes called denitrifiers). This soil bacterial "team" of cronies keeps this cycle going.

Nitrogen bacteria teach us that we are also crucial part of a team that keeps the atmosphere cycle rolling.

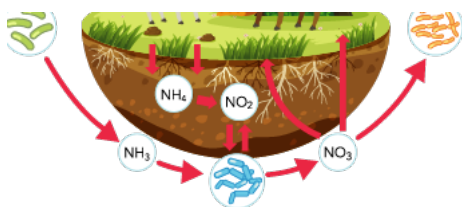
Team Plants and Us

We are part of Mother Earth's cycle of atmospheric gases. Our lungs need oxygen and our trees need CO₂.



Fig. 52. We team up with photosynthetics to cycle oxygen and carbon dioxide.

Fig. 53. Nitrogen bacteria teach how to convert something toxic to plants (nitrite) into something beneficial (nitrate).



In a similar way, you and I have the power to create a coronavirus purge cycle by getting in sync with the powerful exchanges of breath we share with the photosynthetics and with all of the microbes of the nitrogen cycle.

How do we get in sync with nitrogen bacteria when we do not cycle the same gases? After all, we toss the ball of carbon dioxide and oxygen back and forth with plants, and nitrogen bacteria toss around nitrogen gas. Well, we actually do breathe in nitrogen gas, along with oxygen. But the nitrogen gas stays inert (does not change) when we breathe it in and out of our lungs. That is because we do not have nitrogen bacteria in our lungs that can convert this nitrogen gas to oxygenated nitrogen compounds, NO/NO_2 and NO_3 , the way they do in the soil. If we did have nitrogen microbes in our lungs, we could work together as a team to cycle out the virus as we do with our oxygen and nitrogen. This is because *Nitrobacter*, *Nitrospira*, and other nitrogen microbes make NO/NO_2 and NO_3 from nitrogen gas. These types of nitrogen/oxygen combos are toxic to viruses. What if we could do this ourselves? What if we could combine nitrogen gas and oxygen the way that nitrogen bacteria do? After all, we have trillions of Microbe Animal Guides that are showing us how to do this. The meditation that was taught to me by these nitrogen bacteria allows us to channel their abilities in a spiritual sense, to *imagine* creating the toxic gases that would inactivate the coronavirus.



Fig. 54. We participate in the oxygen/carbon dioxide cycle, giving plants CO_2 , while nitrogen bacteria cycle nitrogen gas, giving plants nitrate.

The Coronavirus Purge Meditation involves tuning into the way nitrogen bacteria "breathe."

To do this, we will envision how this microbe changes nitrite, which is toxic to plants, to nitrate, which does not hurt plants. By analogy, we can ask this Microbe Guide to teach us how to change the COVID-19 virus from something toxic to humans into a harmless little husk that can no longer make us sick. Then we can breathe out this inactivated virus husk.

Meditation to Cleanse the Lungs of Our Planet

This meditation can be done whether or not you have the coronavirus. This meditation is meant to envision the removal of the COVID-19 virus from our collective lungs.

When we breathe in oxygen and nitrogen, we can ask *Nitrobacter*, *Nitrospira*, and the other nitrogen bacteria to create these virus killer compounds for us from the ingredients we inhale—that is, from oxygen and nitrogen. This would be done in a figurative sense. Or, if you will, it is accomplished on the astral plane, where our consciousness and that of the nitrogen Microbe Guides can intersect and comeingle. We cannot do this on the corporeal plane, as the creation of NO/NO₂ and NO₃ in our lungs would be lethal. But we can ask the nitrogen bacteria to use their powers to create the *nitro-ox* compounds on the astral plane of consciousness. And we can join the nitrogen Microbe Guides to combine the nitrogen and oxygen we breathe into those nitrogen/oxygen compounds that can inactivate, or even kill, the virus.

Please go to the chapter titled “**Meditations to help you purge the virus and increase immunity**” to learn the Coronavirus Purge Meditation.

10 - Where to Learn More about the Novel Coronavirus Science and Medicine

American Society for Microbiology - Resource for free articles. Some examples listed here.

1 - On coronavirus treatments

<https://asm.org/Articles/2020/July/The-Promise-of-COVID-19-Convalescent-Plasma-Therap>

2 - How COVID-19 tests work

<https://asm.org/Articles/2020/August/How-the-SARS-CoV-2-EUA-Antigen-Tests-Work>

Podcasts by lead virologists

1 - This Week in Virology (TWiV)

<https://asm.org/Podcasts/TWiV/Episodes/An-Iowa-caucus-of-viruses-TWiV-538>

YouTube videos

1 - [Lectures in Virology](#) - by Columbia Professor Vincent Racaniello

2 - Web TV <https://www.youtube.com/c/VincentRacaniello>

Nature - How the pandemic might play out in 2021 and beyond

<https://www.nature.com/articles/d41586-020-02278-5>

CDC website

<https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/about-face-coverings.html>

A paper on natural remedies

Int. J. Biol. Sci. 2020, Vol. 16 <http://www.ijbs.com>

International Journal of Biological Sciences
2020; 16(10): 1708-1717. doi: 10.7150/ijbs.45538

Review

*Traditional Chinese Medicine in the Treatment of
Patients Infected with 2019-New Coronavirus
(SARS-CoV-2): A Review and Perspective*

Yang Yang, Md Sahidul Islam, Jin Wang, Yuan Li, and Xin Chen

11 - Meditations to Help You Purge the Virus and Increase Immunity

Meditations and shamanic journeying are examples of what is considered the psychospiritual aspect of modern medicine.⁶⁸

When I say "to help you purge the virus," I am talking about invoking this psychospiritual tool of Microbe Whispering in combination with the practical actions advised by medical practitioners and public health experts. Please use these meditations in conjunction with the best medical health care advice, physical barriers, and medicine that is available to you.

Step 1 - Allow your mind to reach the altered state of consciousness I have described above.

Step 2 - Face a plant or other photosynthetic organism (the algae in your aquarium, for example).

Step 3 - Take some deep breaths, close your eyes, and hold a picture of the coronavirus in your mind.

Step 4 - Once you have that image in your mind, say: "Nitrogen microbes, please let me enter your microscopic world."

Step 5 - Play this video while breathing in and out slowly and quietly. (Click on image to play the video.)



Fig. 55. The Coronavirus Purge Meditation (click on image to access the video).⁶⁹

Disclaimer: This meditation is intended as an empowering visualization only. No suggestion is being made for humans to try to intake or breathe in NO, NO₂, or NO₃, as these compounds are not compatible with a human or animal respiratory system.

If you believe you have COVID-19, please reach out to the appropriate medical providers for assistance.

Fig. 56. Microbes for Immunity video (click on image).⁷⁰



Microbiomes in our gastrointestinal tract are responsible not just for our digestion, but also for making us immune to disease. To empower you as we face the onslaught of COVID-19, I offer a meditation called "Microbes for Immunity." This meditation will awaken the spirit of the microbes in your gut microbiome as you take action to produce a strong immune system.

Meditation can create a shift of consciousness that will lead you to make better food choices and better experience choices, leading to an increase in your gut microflora of microbes that generate a strong and powerful immunity. There are already microbes in your gut responsible for keeping out harmful microbes, such as the coronavirus that causes COVID-19. But if you are not eating a proper diet for good microbes, these immunity microbes are not as abundant. Naming the

microbes is important, as you know from learning about the microbes in the *Microbe Whisperer Guidebook* (to purchase, go to <https://microbewhisperer.com/product/microbe-whisperer-animal-guide-cards/>).⁷¹

Just identifying a few main representatives of this collective will go a long way to open the channels of communication with these marvelous microbes that inhabit your gut.

Let's get the message to those microbes of immunity by Microbe Whispering to them as part of your multilayered defense against COVID-19!

Conclusion

Thank you, aspiring Microbe Whisperer, for your visit to the "Hall of Viruses" inside the Microbe Whisperer Aquarium. It is my hope that the knowledge you gained from your visit allowed you to observe the COVID-19 virus with fascination rather than fear. During your visit, you were enabled to view the novel coronavirus in approximations of its natural habitat. And you were given the chance to appreciate its nature more fully through the aquarium tank glass.

With the knowledge and the tools provided by this booklet, you have more control over your reactions to this viral pandemic.

I also hope to have given you some solace and comfort by introducing the microbes as animal guides, as well as highlighted awareness that you, the planet, and I are enveloped in and encrusted with trillions of beneficial microbes. At the intersection of the ethereal plane, we can whisper to these trillions of Microbe Spirit Guides as one would intone a mystical prayer when doing shamanic medicine. Enjoy the new realizations of our symbiotic existence in this corporeal world as we solve the mysteries and the realities of this pandemic together.

With Joy and Good Health Blessings to you all, dear aspiring Microbe Whisperers!

Dr. JeM YinJoy at Microbe Whisperer.com
November 2020

[Giuliana Viglione, "How many people has the coronavirus killed?" *Nature*, September 1, 2020. <https://www.nature.com/articles/d41586-020-02497-w>.](https://www.nature.com/articles/d41586-020-02497-w)

² Luisi (Orig Life Evol Bios 28:613–622, 1998); Cleland, Chyba (Orig Life Evol Bios 32:387–393, 2002)

³ For a visual reference of the size differences between microbes, please take a look at this video created by MetaBallStudios (MBS) artisan A. Gracia Montoya. <https://youtu.be/h0xTKxbIEIU>

⁴ Microbe Whisperer Cards for Environmental Healing (Guidebook).

<https://www.amazon.com/Microbe-Whisperer-Environmental-Divination-Education-ebook/dp/B07L288WV7>

⁵ MINI ORGANS REVEAL HOW THE CORONAVIRUS RAVAGES THE BODY

Smriti Mallapaty

Nature | Vol 583 | 2 July 2020

pp 15–16.

⁶ Microbe Whisperer Cards for Environmental Healing (Guidebook), by Dr. JeM YinJoy, Ph.D., Microbe Whisperer, LLC.

https://www.amazon.com/dp/B07L288WV7?ref=k4w_oembed_L7xywJeSCDIsm&tag=kpembed-20&linkCode=kpd

⁷ F.W. Twort L.R.C.P. LOND., M.R.C.S. "An investigation on the nature of ultra-microscopic viruses," *The Lancet* 186, no. 4814 (December 1915): 1241–1243.

⁸ d'Herelle, F. (1917). Sur un microbe invisible antagoniste des bacilles dysentériques. CR Acad. Sci. Paris 165, 373–375.

⁹ Stephen T. Abedon, Sarah J. Kuhl, Bob G. Blasdel & Elizabeth Martin

Kutter (2011) Phage treatment of human infections, *Bacteriophage*, 1:2, 66–85, DOI: 10.4161/bact.1.2.15845. <https://doi.org/10.4161/bact.1.2.15845>

¹⁰ Ibid.

¹¹ Fleming, A. (1945). Penicillin's finder assays its future. *The New York Times*, June 26, 1945. A21. <https://www.nytimes.com/1945/06/26/archives/penicillins-finder-assays-its-future-sir-alexander-fleming-says.html>

¹² Marshall, G., Blacklock, J.W.S., Cameron, C., Capon, N.B., Cruickshank, R., Gaddum, J.H., et al. (1948). STREPTOMYCIN treatment of pulmonary tuberculosis. *BMJ* 2, 769–782.

¹³ Spellberg, B., Gidos, R., Gilbert, D., Bradley, J., Boucher, H.W., Scheld, W.M., Bartlett, J.G., and Edwards, J., Jr.; Infectious Diseases Society of America (2008). The epidemic of antibiotic-resistant infections: a call to action for the medical community from the Infectious Diseases Society of America. *Clin. Infect. Dis.* 46, 155–164.

¹⁴ Ibid.

¹⁵ WHO - World Health Organization. https://www.who.int/emergencies/diseases/novel-coronavirus-2019?gclid=Cj0KCQjw5eX7BRDQARIsAMhYLP-alw_zLaar_MtluBNNkCAXYifZ-DFA1SC8EHKZLFHANm-NiNuXvtQaAtmmEALw_wcB

¹⁶ Watanabe, R., Matsumoto, T., Sano, G., Ishii, Y., Tateda, K., Sumiyama, Y., Uchiyama, J., Sakurai, S., Matsuzaki, S., Imai, S., and Yamaguchi, K. (2007). *Cell Host & Microbe* 25, February 13, 2019 231

Cell Host & Microbe

Review
Efficacy of bacteriophage therapy against gut-derived sepsis caused by *Pseudomonas aeruginosa* in mice. *Antimicrob. Agents Chemother.* 51, 446–452.

¹⁷ Capparelli, R., Parlato, M., Borriello, G., Salvatore, P., and Iannelli, D. (2007). Experimental phage therapy against *Staphylococcus aureus* in mice. *Antimicrob. Agents Chemother.* 51, 2765–2773.

¹⁸ Cervený, K.E., DePaola, A., Duckworth, D.H., and Gulig, P.A. (2002). Phage therapy of local and systemic disease caused by *Vibrio vulnificus* in iron-dextran-treated mice. *Infect. Immun.* 70, 6251–6262.

¹⁹ Galtier, M., De Sordi, L., Sivignon, A., de Valle, A., Maura, D., Neut, C., Rahmouni, O., Wannerberger, K., Darfeuille-Michaud, A., Desreumaux, P., et al.

(2017). Bacteriophages targeting Adherent invasive *Escherichia coli* strains

as a promising new treatment for Crohn's disease. *J. Crohn's Colitis* 11, 840–847.

²⁰

<https://reader.elsevier.com/reader/sd/pii/S1931312819300526?token=798DFD844C4C13018A42D33A07C549F0316F0D150BDCF1EE4C9C9230FBE510DBF4506EBA01E82E99D8375B376D67FBAD>

²¹ Wikipedia

²² *International Journal of Antimicrobial Agents*, Vol. 55, Issue 6, June 2020, L. Wang et al.

²³ Ibid.

²⁴ Wikipedia

²⁵ *Nature Microbiology* | VOL 5 536 | March 2020 | 536–544 | www.nature.com/naturemicrobiology

²⁶ *Journal of Advanced Research* 24 (2020) 91–98

Middle Eastern countries

COVID-19 infection: Origin, transmission, and characteristics of human coronaviruses

Muhammad Adnan Shereen, Suliman Khan, Abeer Kazmi, Nadia Bashir a, Rabeea Siddique

²⁷ Ibid.

²⁸ Ibid.

²⁹ *Clin Microbiol Infect* 2011; 17: 326–330

³⁰ Professor Vincent Racaniello, Virology Lectures 2020, Columbia University

³¹ *ILAR Journal*, 2017, Vol. 58, No. 3, 315–318

³² *International Journal of Biological Sciences*

2020; 16(10): 1686–1697. doi: 10.7150/ijbs.45472

Review

Zoonotic origins of human coronaviruses

Zi-Wei Ye1, Shuofeng Yuan1, Kit-San Yuen2, Sin-Yee Fung2, Chi-Ping Chan2, and Dong-Yan Jin2

³³ Professor Vincent Racaniello, Virology Lectures 2020, Columbia University

³⁴ *Journal of Advanced Research* 24 (2020) 91–98

³⁵ *Journal of Advanced Research* 24 (2020) 91–98

³⁶ COVID-19 Dashboard by CSSE at Johns Hopkins University: <https://coronavirus.jhu.edu/map.html>

³⁷ <http://web.stanford.edu/~kaleeg/chem32/biopol/>

³⁸ <https://socratic.org/questions/what-nucleic-acid-contains-uracil>

³⁹ <https://www.technologynetworks.com/genomics/lists/what-are-the-key-differences-between-dna-and-rna-296719> - :~:text=DNA double helix means that,mRNA and tRNA molecules pair.

⁴⁰ Credited to George Rice, Montana State University

⁴¹

https://books.google.com/books?id=AsJDTq2wTQEC&pg=PA12&lpg=PA12&dq=batesian+mimicry+in+moth+from+soot+in+industrial+revolution+bates&source=bl&ots=8eTBITJd8l&sig=ACfU3U2OvVNBC1_IKoo9vImY-saRazyurA&hl=en&sa=X&ved=2ahUKEwiUwcl2t7fqAhUXITQIHcnAsIQ6AEwAHOECAoQAAQ#v=onepage&q=batesian%20mimicry%20in%20moths%20from%20soot%20in%20industrial%20revolution%20bates&f=false

⁴² https://elearning.uniroma1.it/pluginfile.php/867900/mod_resource/content/1/Origin-of-life-The-RNA-world1986Nature.pdf

The RNA World - Walter Gilbert

Nature Vol. 219 20 February 1986

⁴³ Matt Cirigliano. <https://www.youtube.com/watch?v=ehbZpo8oXSs>

⁴⁴ Angus Chen, "Sea Nomads' May Have Evolved to Be the World's Elite Divers," *Scientific American*, April 19, 2018, <https://www.scientificamerican.com/article/human-sea-nomads-may-have-evolved-to-be-the-worlds-elite-divers/>.

⁴⁵ Available online at www.sciencedirect.com

ScienceDirect

Metabolic adaptation to high altitude

Katie A. O'Brien, Tatum S. Simonson and Andrew J. Murray

⁴⁶ Virology 2020 lectures, Vincent

Racaniello, Columbia University

99

⁴⁷ <https://www.niaid.nih.gov/research/immune-system-overview>

⁴⁸ Virology 2020 lectures, Vincent

Rancaniello, Columbia University

⁴⁹ <https://www.contagionlive.com/news/the-covid19-live-vaccine-tracker>

⁵⁰ <https://www.mayoclinic.org/diseases-conditions/coronavirus/in-depth/herd-immunity-and-coronavirus/art-20486808>

⁵¹ Journal of Advanced Research 24 (2020) 91–98

⁵² Volume 182, Issue 3, 6 August 2020, Pages 744-753.e4

A SARS-CoV-2 Infection Model in Mice Demonstrates Protection by Neutralizing Antibodies

Author links open overlay panel. Ahmed O.Hassan, James BrettCase, Emma S.Winkler, Larissa

B.Thackray, Natasha M.Kafai, Adam L.Bailey, Broc T.McCune, Julie M.Fox, Rita E.Chen, Wafaa B.Alsoussi,

Jackson S.Turner, Aaron J.Schmitz, TingtingLei, SwathiShrihari, Shamus P.Keeler, Daved H.Fremont,

SuellenGreco, Paul B.McCrayJr....Michael S.Diamond

⁵³ <https://microbewhisperer.com/2019/03/17/microbes-from-ireland-our-lucky-charms-for-health/>

⁵⁴ <https://microbewhisperer.com/2019/11/28/cultivate-a-diverse-microbe-gut-while-holiday-feasting/>

⁵⁵ <https://microbewhisperer.com/2020/03/03/a-microbe-animal-guide-reading-on-covid-19/>

⁵⁶ <https://microbewhisperer.com/2020/03/03/a-microbe-animal-guide-reading-on-covid-19/>

⁵⁷ <https://microbewhisperer.com/2019/11/28/cultivate-a-diverse-microbe-gut-while-holiday-feasting/>

⁵⁸ <https://theconversation.com/meet-the-trillions-of-viruses-that-make-up-your-virome-104105>

⁵⁹ <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2843952/>

⁶⁰ <https://cleanfax.com/restoration/air-filtration-devices/>

⁶¹ <https://www.ashrae.org/technical-resources/filtration-disinfection>

⁶² <https://www.sciencedirect.com/topics/engineering/high-efficiency-particulate-air-filter>

⁶³ <https://www.ny-engineers.com/blog/coronavirus-response-how-to-rapidly-build-field-hospitals>

⁶⁴ https://www.spycor.com/OMNIAIRE-OA1200PAC-Medial-Grade-Air-Cleaner-p/oa1200pac.htm?gclid=CjwKCAjw1ej5BRBhEiwAfHyh1NscG2TPow09L2Uy6Vpz7eSVQ_dX5s-_wlm2tEilmQM8RvKjX-QJhoCS8MQAvD_BwE

⁶⁵ https://www.uvdi.com/wp-content/uploads/2020/03/News-Release-Mar2020_MKTFM-453-Rev-A-1.pdf

⁶⁶ <https://cen.acs.org/environment/water/stripping-air-moisture-quench-worlds/96/i41>

<https://drinkableair.tech/awg-technology/>

⁶⁷ <https://youtu.be/x1SgmFa0r04>

⁶⁸ <https://ndnr.com/mindbody/psychospiritual-medicine/>

Dr. Candice Pert - Molecules of Emotion

<https://www.amazon.com/Molecules-Emotion-Science-Mind-Body-Medicine/dp/0684846349>

⁶⁹ https://www.youtube.com/watch?v=tFSX-MZ_P9s&feature=youtu.be&app=desktop

⁷⁰ <https://www.youtube.com/watch?v=NkLLG9SLzk0&feature=youtu.be&app=desktop>

⁷¹ <https://microbewhisperer.com/product/microbe-whisperer-animal-guide-cards/>